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Things Which Live or Which Have Lived

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ANTONY van LEEUWENHOEK

A Review of His Life and Work*

SIDNEY SHAPIRO
Forest Hills, New York

IN these days of concentration upon complex instrumentation we tend to become engrossed in the design and mechanics of instruments and too often overlook their fundamental purpose. This is especially true of those of us who are engaged in microscopy. Necessary as the tremendous complexity of instruments may be to us, and aware as we are that our needs and demands have created them, who among us can honestly declare that he has never experienced exultation in the mere manipulation of a gorgeously machined knob? It is valuable therefore to pause and look back a few centuries to review the work of a man whose instrumentation was ingenious, yet whose principal concern was the observations it made possible. With the simplest of devices he began the first studies of a great variety of previously unknown microorganisms.

Until recently most of us were ill-informed regarding Antony van Leeuwenhoek. Highly condensed paragraphs appeared in encyclopedias and general biology texts, while the comprehensive works such as that by Hoole[5] published in 1800, were rarely seen in libraries. Paul de Kruif awakened interest in the man when he included him among his *Microbe Hunters*[8], but it was not until 1932 when Clifford Dobell's monumental work[2] appeared that the ordinary student had at last available to him really authoritative information about Leeuwenhoek.

Dobell points out that many misconceptions were perpetuated as a result of mistranslation from Leeuwenhoek's colloquial Dutch to the Latin, then to English. Hence, Dobell made a study of the Dutch language of Leeuwenhoek's time and translated directly to English from the original manuscripts. He justifies his efforts on the grounds that, as a protistologist, whenever he began an investigation of a particular organism, he almost invariably was brought back to Leeuwenhoek as having made the first known observation.

Antony van Leeuwenhoek was born in the town of Delft, Holland, on October 24, 1632. He died in his native town on August 26, 1723, being then aged, as his epitaph tells us, "90 years, 10 months and 2 days."

Not much is known of Leeuwenhoek's parents. His father, Phillip, a basket maker in the east end of Delft, was a craftsman of good Dutch stock but of no personal or social distinction. His mother was Margaretha Berch, daughter of a Dutch brewer. She belonged to a good family and was related to other Dutch families of equally good standing. Since brewers, then as now, were no inconsiderable folk in Holland, it seems clear that any claims which An-

*Received for publication May 19, 1955.

Figure 1. Early microscopes from Schott's "Magia Optica."

tony may have had to gentle birth must rest upon his mother. It is interesting to note that the Leeuwenhoeks, for several generations at least, were consistently named Phillip and Antony alternately, a system of naming common in Holland at that time. The family tree indicates that Leeuwenhoek himself made three unsuccessful attempts to rear a son called Phillip.

Antony was one of seven children, four of whom were older than himself. He received his early education in a small school north of Leyden. Next he went to live with an uncle who was an attorney, which gave rise to the belief that he was contemplating a similar career. But there appears to be little foundation for such a supposition, because, as he was never taught Latin, it is unlikely that he was destined for the law or for the University.

Whatever his family's intentions may have been, we do know that he never progressed far in his preparation for the law or for the University. It was perhaps at the time spent in his uncle's house that he acquired those rudiments of mathematics and physical science in which he so delighted in later life. Yet it is certain that he received no instruction in languages, for to his dying day he knew none but his native tongue. Indeed all his works were written in Dutch, the Latin translations being done during his old age by scholarly friends of the Royal Society of London.

At the age of 16 he went to serve as an apprentice in a merchant's shop in Amsterdam. After six years however,

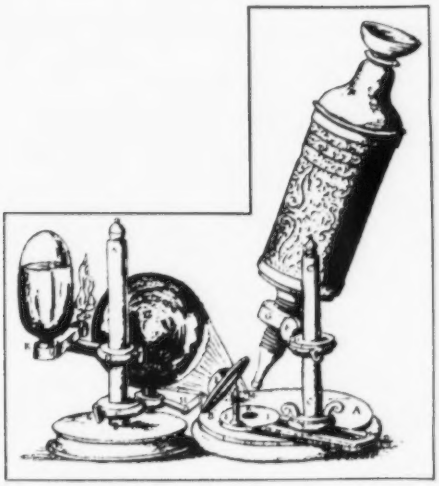

Figure 2. Hooke's compound microscope, about 1660.

he returned to Delft, and there he remained until his death. During his stay in Amsterdam he became acquainted with the famous Swammerdam and perhaps other young men with congenial interests, all of whom must have had a profound effect upon the course of his later life and work.

Upon his return to Delft he soon obtained the office of Sheriff's Chamberlain, which yielded him a small income with apparently little labor, and to this occupation he settled down for life. In his leisure time he began to make and use magnifying glasses, and before he had reached middle life his "microscopic" demonstrations had become celebrated. De Graff introduced him to the Royal Society of London, which printed his first paper in 1674 and to which most of his subsequent papers were sent. Swammerdam repeatedly examined his preparations, and any distinguished person, such as the Duke of York, or Peter the Great, who happened to visit Holland, was taken to look at Leeuwenhoek's microscopes as chief curiosities of the day.

Leeuwenhoek did not methodically pursue any one science; his curiosity led him to examine a great variety of minute objects, and he found something new in every one. If we feel inclined to criticize Leeuwenhoek's hasty methods, it is well to remember that he initiated biological inquiries of the greatest interest many of which are enumerated in another part of this paper.

Before we look at Leeuwenhoek's instruments it is well to point out that other instruments were being used before and during his lifetime. Figures 1 through 6 show some of these early microscopes.

The honor of making the microscope the common property of science belongs to Galileo. About 1608 he made his first telescope and with this combination of lenses he not only made observations on the celestial bodies, but in 1609 also published observations on minute objects. Who actually discovered the microscope, or more particularly the compound microscope, it still in dispute. Certainly it was in use before Leeuwenhoek was

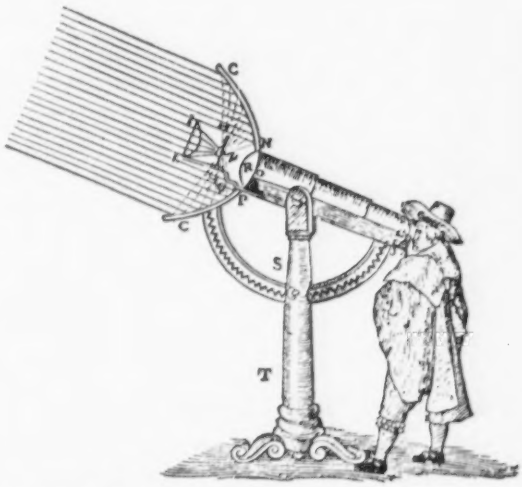

Figure 3. Descartes' representation of an "Ideal Microscope", 1637.

born. The *Encyclopedia Brittanica*[4] states that "he found that single lenses of very short focus were preferable to the compound microscopes then in use." This implies that Leeuwenhoek was aware of their existence, yet Dobell insists that he was ignorant of them. Evidence to support Dobell's view lies in the fact that he developed his instruments independently, originating the principle of the fixed objective. His method was to fasten the lens in a hole of the stage of the mechanism and to affix his specimen to a system of screws designed to bring the object of his scrutiny into the focus of the lens. Thus, whoever eventually is proved to be the "inventor" of the microscope, it is probable that pre-existing instruments had no influence whatever upon the work and discoveries of Leeuwenhoek.

The instruments which Leeuwenhoek made for himself were not compound microscopes but simple double convex lenses of various powers. So much light was lost that the higher powers were effective only when the object was transparent and directly illuminated by the sun. Leeuwenhoek found that the adjustment of one of his lenses to the object was too difficult a task for inexperienced

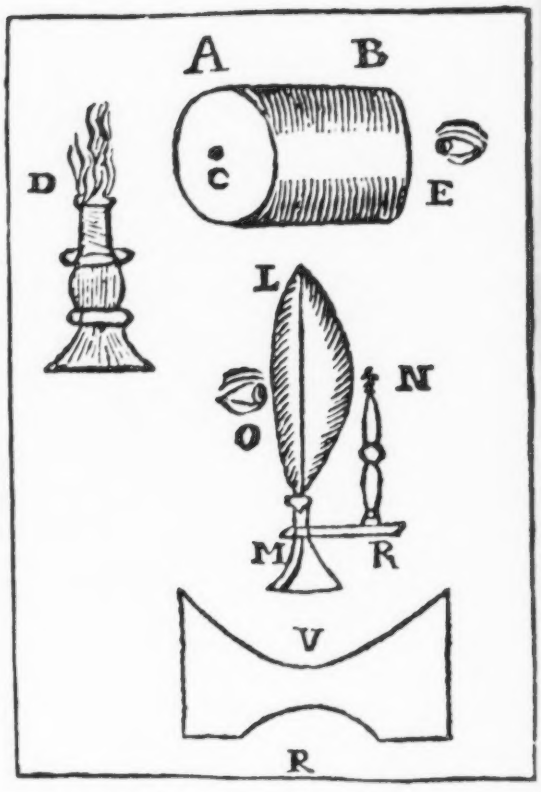

Figure 5. Kirscher's microscope, 1646.

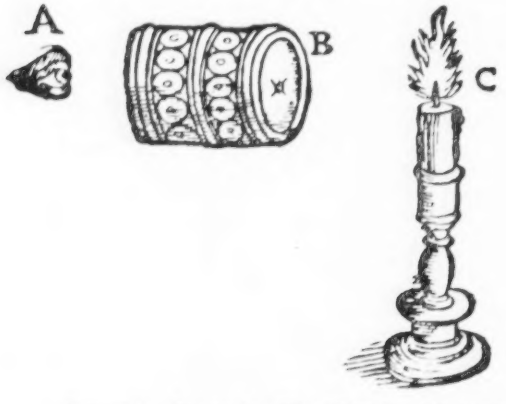

Figure 4. An early "Flea-Glass" with ornamentation of the tube.

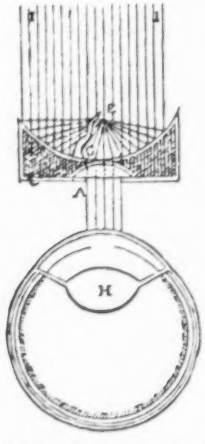

Figure 6. Earliest known printed picture of the simple microscope, 1637.

hands, and when he sent his preparations a distance it was his practice to devote a separate lens to each object, and to fix everything in its place. He was preoccupied with the effectiveness of the lens itself and thus spent little time with careful finishing of the rest of the instrument. Although he fashioned instruments from many different materials — brass, copper, silver, and occasionally even gold — a single instrument was always made of one metal alone. We can attribute the crude appearance of his instruments to his concentration upon the optical part of the "microscope", for when he had succeeded in grinding, polishing and mounting a good lens, he wasted no time in finishing the mechanical part, making it just good enough for his purpose. Contrast this attitude with the vogue of elaborate carving and engraving of non-essential parts of scientific instruments which persisted into the nineteenth century.

In 1933, to commemorate the 300th anniversary of Antony van Leeuwenhoek's birth, the *Bausch and Lomb Company* manufactured as a souvenir a limited number of replicas of a Leeuwenhoek microscope. I was fortunate enough to be able to borrow one of these instruments*. It is almost an exact duplicate of the sample shown in Figure 7, Leeuwenhoek's own representation of one of his instruments. Figure 8 shows its small size and the manner in which it was held. I am informed by a qualified representative of the *Bausch and Lomb Company* that the lens mounted in their commemorative replica was a single element from one of their high power dry objectives and consequently as far as surface accuracy is concerned was finished to a high quality. While

*Courtesy of Dr. Samuel R. Detwiler, Professor of Anatomy, College of Physicians and Surgeons, Columbia University, New York.

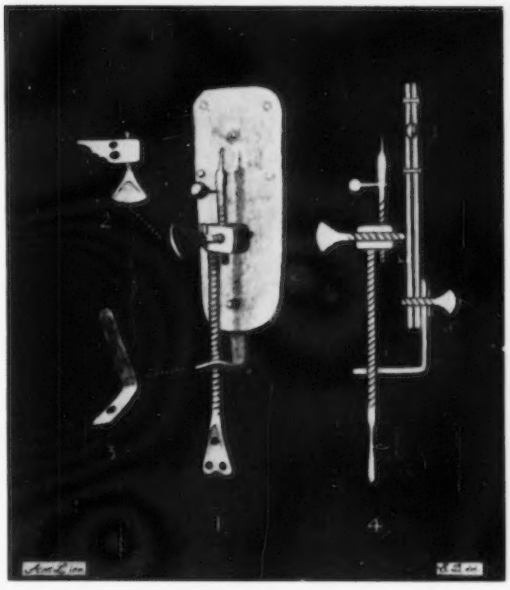

Figure 7. Leeuwenhoek's own representation of one of his instruments. A remarkably clear, self-explanatory illustration.

it is probably not valid to compare this lens with those made by Leeuwenhoek, it nevertheless seemed of interest to attempt its use in making a number of photomicrographs. Figures 9 and 10 are the result of this attempt. This is as close as the writer can come to conveying in print some visual indication of what Leeuwenhoek was able to see with one of his instruments.

Dobell states that all of Leeuwenhoek's lenses examined by him were remarkably free of abberation and compared favorably with modern objectives of like power in his possession. Unfortunately for us, Leeuwenhoek never divulged his formulae or methods of making his objectives, jealously guarding his "secrets" from his contemporaries and from posterity.

It has already been pointed out that all of Leewenhoek's instruments utilized the principle of the fixed objective and

Figure 8. Photograph of the Bausch and Lomb replica of a Leeuwenhoek microscope showing the manner in which it was held. Note the close resemblance to instrument shown in Figure 7.

the movable specimen. In the *B. & L.* replica this is clearly seen, but this particular example provides a sharp point for impaling some small object for examination. Leewenhoek's variation in instrumentation involved changing the method of mounting the specimen and in some instances attempting to improve illumination. (See Figures 11 and 12).

The modern microscopist can make measurements with relative ease, but to Leeuwenhoek the need for measuring small lengths or areas was an insurmountable problem. It was not from want of trying, however, that his estimates of size were sometimes far from accurate. He could only make reference to objects of more or less known dimension; a sand grain, a human red blood cell, a vinegar eel, a millet seed, a hairsbreadth, the diameter of a louse's eye, or the bigness of a hair on a louse. Sand grains were his common standard of comparison. A fine sand grain he took to be 1/100th of an inch in diameter, while a coarse sand grain he considered to be about 1/30th of an inch in diameter. Figure 13 shows the manner in which Leeuwenhoek indicated the magnitude of organisms he described.

Leeuwenhoek's discoveries were many; diversified, and all of tremendous importance to biological science. Not being competent to evaluate their relative importance, I will touch briefly upon some of his investigations, for it is my intention in this paper merely to indicate the prodigious industry of this man. Hardly a subject was neglected by him.

He initiated the study of parthenogenesis in aphids and the revivification of dried microscopic organisms. He gave the first accurate descriptions of Rotifers, Hydra, Infusoria, yeast-cells and bacteria.

Leeuwenhoek extended Harvey's theory of the circulation of the blood. Malpighi had already shown that innumerable capillary vessels connect the arteries and veins in the lungs, the mesentery and the bladder of the frog. Leeuwenhoek demonstrated the capillary flow more clearly by using the tail of the tadpole and the fish, the web of the frog's hind foot and the membrane of the bat's wing. It is interesting here to note that all of these organs are relatively transparent and were among the only possible places where, with Leeuwenhoek's limited illumination, the demonstrations could be made.

Malpighi had seen red blood corpuscles in the blood of a hedgehog, but had mistaken them for fat cells. Swammerdam had found them in the blood of man and frog. Leeuwenhoek discovered them in his own blood and he published his discovery in 1674. He went on to describe the varying shapes of blood corpuscles in different classes of animals, all quite accurately.

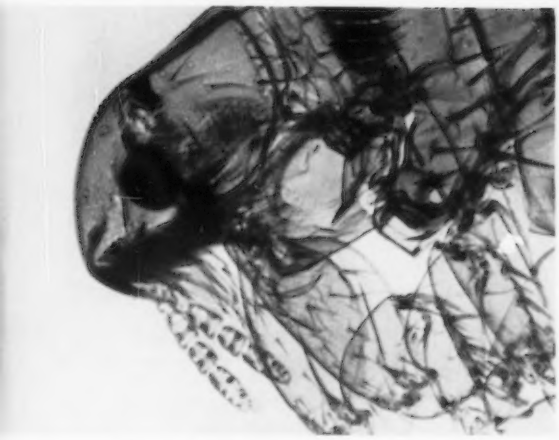

Figure 9. Photomicrograph of the head of a flea, approximately 30X, made with the lens of the Bausch and Lomb replica.

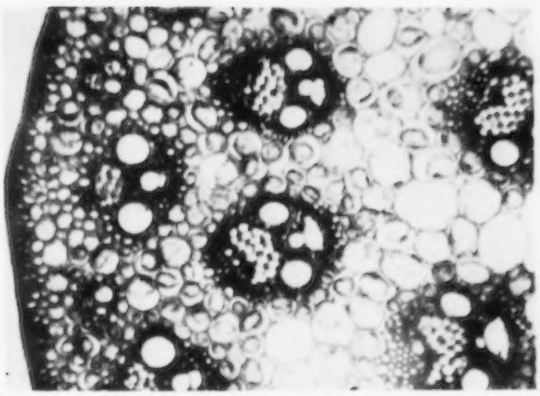

Figure 10. Photomicrograph of a transverse section of a monocotyledonous stem, approximately 30X, made with the lens of the Bausch and Lomb replica.

Leeuwenhoek recognized human spermatozoa, although with erroneous interpretation. He relates that in 1677 a young physician named Hamm demonstrated spermatozoa in his presence, and he lost no time in communicating his findings to the Royal Society in London. His figures are very curious, some of them strangely like human beings with heads, arms and legs. Here is one instance where he deviated from his usual accuracy of representation and allowed his preconceived notions and imagination to influence his reporting.

Leeuwenhoek demonstrated the structure of the crystalline lens of the eye. He made accurate observations on the compound eyes of insects and crustaceans. He gave the first known description of the transverse striations of muscle tissue, the structure of the dentyne of the teeth and the cells of the epidermis.

Much of his time and attention was given to a long series of investigations into spontaneous generation, a theory he decidedly opposed. In the course of these studies he ascertained and proved, among other results, that oak-galls are caused primarily by the development of an insect's egg deposited in the bark; that weevils are hatched, not *from* wheat, but from an insect's eggs deposited *in* wheat; that the flea is propogated in a manner similar to other insects, not originated from dust, or sand, or the dung of pigeons, as was commonly believed; that aphids are viviparous; that eels, instead of being produced from dew, are likewise viviparous; and that mussels are not generated from mud or sand, but from spawn.

His inquiries into the growth of plants showed the many differences that exist in the structures of the stems of monocotyledons and dicotyledons.

To those whose particular concern is the translation of the histological section to film and paper, I direct this quotation from Dobell;

"I may also note here that Leeuwenhoek was one of the first — if not the very first — to study the structure of solid opaque bodies by means of sections. Some which he cut with his own hand *by means of a sharp shaving razor*

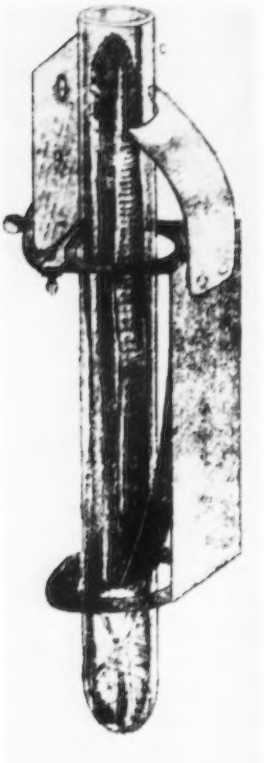

Figure 11. Leeuwenhoek's method of studying the circulation of blood.

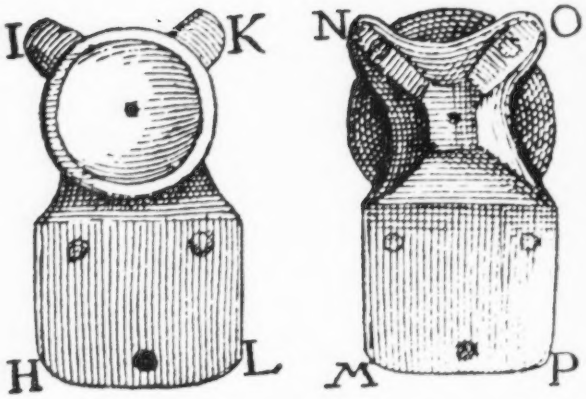

Figure 12. A Leeuwenhoek microscope provided with a concave reflector.

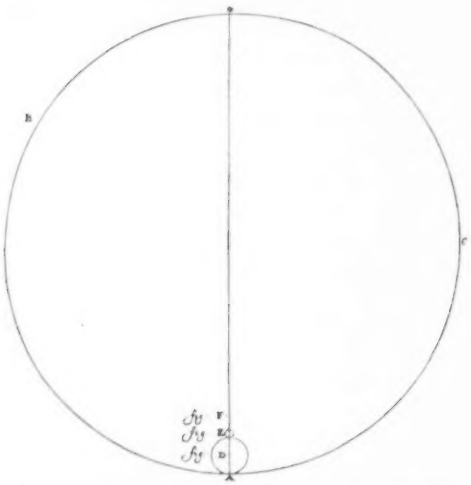

Figure 13. A diagram from one of Leeuwenhoek's letters to the Royal Society of London. The large circle represents the diameter of a sand grain, 1/100 of an inch in this case; the smaller circles represent the diameters of organisms being described. The relationships are visual estimates.

are still in existence. They were enclosed in a little packet affixed to an early letter, and have remained intact to the present day. According to his own description, they are (1) *Cork;* (2) *White of a writing pen* (parings from a quill); (3) *Bits of the optic nerve of a cow, cut crosswise;* (4) *Pith of elder.* He added the following suggestions for looking at these objects:

. . . I would venture to recommend that, when one of these sections has been brought upon the pin of a microscope, you then hold the microscope towards the open sky, within doors, and out of the sunshine, as though you had a telescope and were trying to look at the stars through it."

The greater part of Leeuwenhoek's investigations were published in the *Philosophical Transactions* of the Royal Society of London. His contributions here amounted to 375, while he also sent 26 papers to France. These were published in the *Memoirs* of the Paris

Academy of Science. Leeuwenhoek was a Fellow of both these learned societies.

The Royal Society formerly possessed a set of Leeuwenhoek microscopes and objects, bequeathed by him and described by him as "a small black cabinet, lacquered and gilded, which has five little drawers in it, wherein are contained thirteen long and square tin boxes, covered with black leather. In each of these boxes are two ground microscopes, in all six and twenty: which I did grind myself, and set in silver; and most of the silver was what I had extracted from minerals, and separated from the gold that was mixed with it; and an account of each glass goes along with them."

This cabinet of microscopes has long since disappeared, but the memory of Antony van Leeuwenhoek has remained as a constant source of interest and inspiration

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Stereophotography Utilizing Available 2¼ in. x 3¼ in. and Larger Equipment*

KENNETH D. TOMPKINS** and
JOHN J. BEITER***

Department of Medical Photography, Pathology Laboratories (M. G. Bohrod, M.D., Director) The Rochester General Hospital, Rochester, New York.

THE current revival of three dimensional photography has caused many medical photographers, for one reason or another, to try "stereo". Because of the necessarily high cost of special equipment it has seemed questionable to many workers if the investment is worthwhile. Nevertheless, those who have equipment in the size range of from 2¼ in. x 3¼ in. to 4 in. x 5 in., can try "stereo" with almost no expenditure. Then, after evaluating the results, can decide whether or not this branch of photography presents something of value for further experimentation. The purpose of this discussion is to present a workable means for stereophotography and to clarify some of the basic principles of "stereo" and binocular vision.

The human eye is a remarkable device. It can rapidly adjust itself so that both near or far objects can be seen distinctly. It interprets color, observes objects in motion, estimates distance and, within limits, controls the intensity of the entering light. Since there are two eyes in the human head, human vision is binocular. Certain basic terms are usually used in defining binocular vision. Summarized they are as follow:

Binocular Vision Seeing objects simultaneously with two viewpoints by means of two visual organs.

Stereoscopic Vision The partial overlapping of the visual fields in binocular vision which aids in giving an impression of depth.

Accommodation Ability of the eye to focus objects at different distances.

Retinal Image Disparity Dissimilarity of the retinal images due to the separation of the eyes.

Convergence Faculty of the eyes to change coordinately the direction of their optical axes according to the viewing distance. For objects at infinity the optical axes of the eyes are nearly parallel, but as closer objects are viewed the axes point inward.

Taking The Stereophotograph

As stated above, when the eyes are focused at infinity, the optical axes are almost parallel but converge when focused on a near object. To maintain a stereoscopic relationship, the optical axes of the camera lenses must correspond to those of the eyes. If a stereo camera is moved in a horizontal arc, and its optical axes converge on the subject, the above requirement also is fulfilled. This horizontal movement is sometimes called "shift", which is greater for objects at infinity than for near objects. These distances can be computed by one of several methods. A precise method is the

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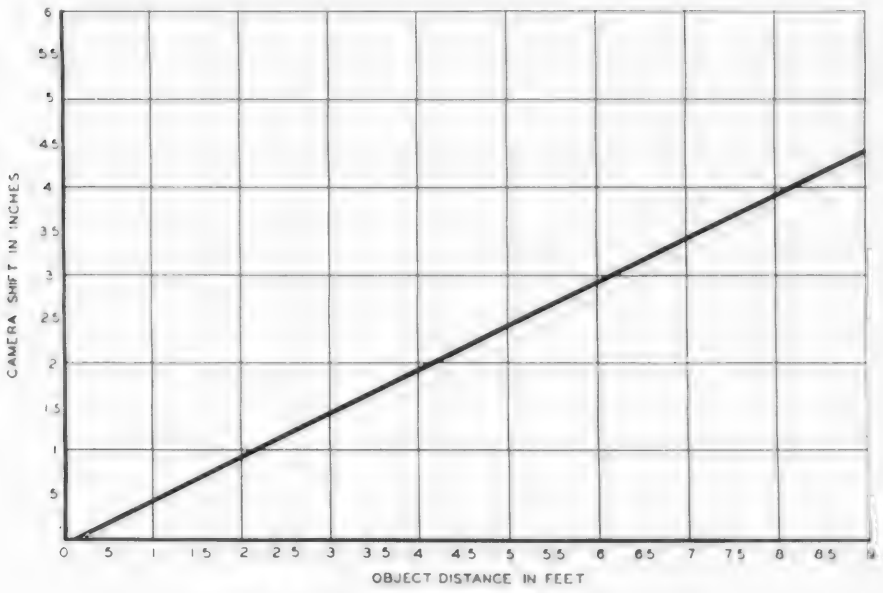

Figure 1. Shift for close and far object distances.

Kurtz System of Orthostereoscopy[1] which was computed for viewing. If this method is used for projecting a transparency, the stereo effect is not noticeably reduced on the screen. The empirical method in use at this hospital is based on 1/25th of the object distance (Fig. 1). This system fits the stereo requirements for most medical subjects. Unusual ones are compensated for by increasing or decreasing the shift. Some type of gadget is needed to provide for the shift. At this institution, an adapted X-ray stand serves the purpose very well (Fig. 2A). A ruler was attached to the locking, sliding bar arrangement (Fig. 2B) and photographs were taken using this scale to adjust the separation. If a stand of this type or one having this arrangement is not available, a plate with a slot for the camera shift, including a ruler for measurement, can be constructed (Fig. 3). The only requirements for such an arrangement, either stand or plate, are that it provide ease of horizontal movements, is graduated linearly, and is sturdy enough to lock in position.

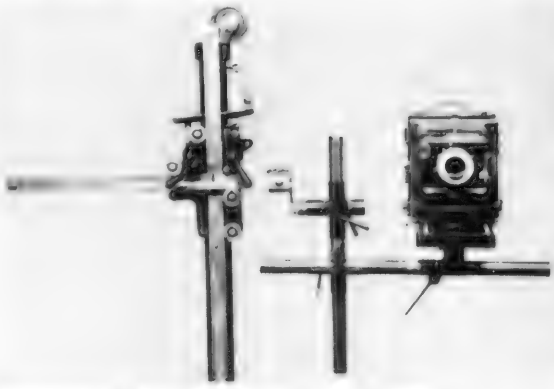

Figure 2(a. Adapted X-ray stand with linearly marked sliding bar.

Mounting

There has been much discussion on the subject of mounting stereo. Within the limits set by the photographic pro- [illegible] is usually [illegible] according to the amount of separation

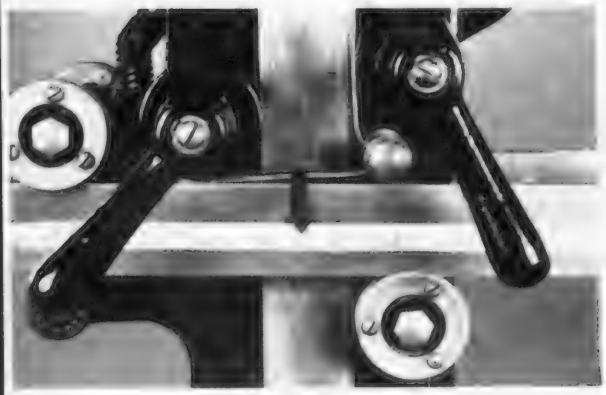

Figure 2(b). Sliding bar with ruler attached

Figure 3. Homemade slotted plate with ruler and camera in position

used. In medical photography, one must avoid illusions or effects sometimes used to eliminate or overemphasize a subject (Fig. 4). The stereo illusion itself is usually enough to emphasize the subject. In the case of mounted transparencies, it has been our experience that the most natural appearance is obtained by mounting the slides in the usual stereo position, i.e., with the subject *slightly* behind the window (Figs. 5 and 6).

To mount the stereo pair, many different devices have been constructed to assure correct relationship between the images and to provide horizontal and vertical alignment of both the glass and mask. However, these devices are costly, require time to manipulate and, when the pair is mounted, the two images are not always in alignment. A simple method devised here permits the stereo pair to be quickly and easily mounted in proper alignment. Essentially, the method consists of superimposing, as closely as possible, the transparencies together with two lantern slide mats of the desired opening. Due to image disparity, the images cannot be *exactly* superimposed, but the difference is small enough so a compromise can be made. After this approximated superimposition (the transparencies being kept in registry together with the two identical mats) two adjacent sides are trimmed at a 90 degree angle. Sometimes it may be desired to decenter the mat. If so, any or all edges may be trimmed. Provided the subject has been imaged slightly off center in the camera, the pair may be trimmed without cutting off any important picture area and will be centered when cropped. A lantern slide cover glass is now placed in contact with each transparency and its mat, then aligned on the 90° chosen corner. The transparency-glass-mask relationship is kept in proper alignment (Fig. 7A). When the transparency is not as large as the mats and cover glasses, for example, when using smaller film sizes such as 2½ in. x 3½ in., there is another simple method that is successful, and which works equally well for 3¼ in. x 4¼ in. or 4 in. x 5 in. (Fig. 7B). This method entails superimposing the two mats and the two transparencies as outlined previously, and punching holes in the composite in diagonally opposite corners. Then each slide is mounted with corresponding holes of the mat and transparency in

Figure 4. Hyperstereo effect (Renal calculus

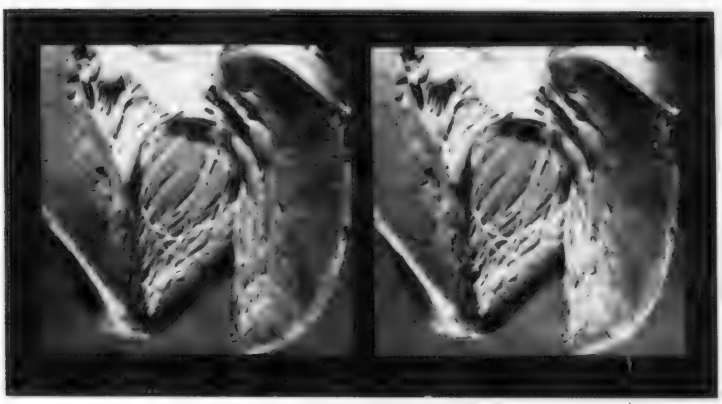

Figure 5. Good stereo effect. Hypertrophic myocardium (Print from color transparency)

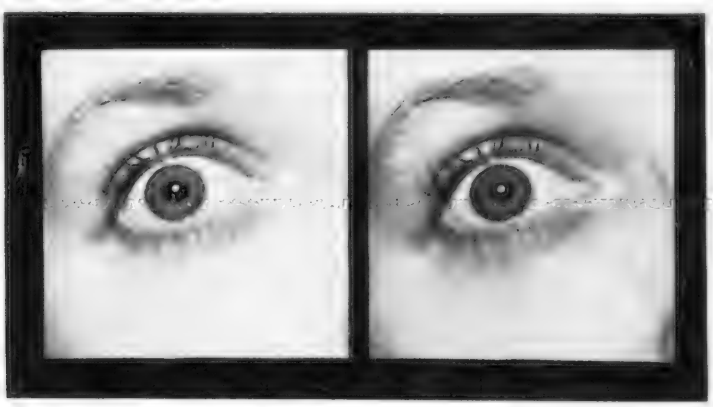

Figure 6. Good stereo effect. Normal eye (Print from color transparency)

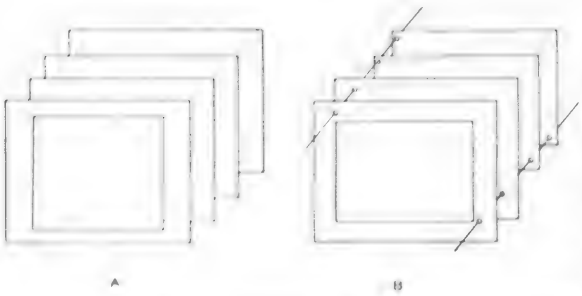

Figure 7. Mounting methods. (A) 90° corner alignment. (B) Punched corner alignment.

registry. Careful attention must be given to the registering, punching and trimming. However, either method is faster and easier than those employing a grid. In miniature stereo photography both views are mounted as a unit and thus can be used only for stereo viewing and projecting. This condition is not encountered with the larger sizes using the above described procedures. Each 3¼ in. x 4 in. slide may be used for ordinary 2D viewing and projecting, or both may be used together to produce one 3D pair.

Viewing

Stereo is based upon binocular vision. The camera has been substituted for the eyes and the photo-pair taken. To view stereo pictures so that the subject is in correct relief, the right eye must see the right image and the left eye the left image. To accomplish this, a viewer should consist of three essential parts: two matched lenses, a separation or baffle, and a holder for the photographs at the focal plane of the lenses. Obviously anyone could construct a viewer if these parts were available. An important factor to remember is that the optical axes of the lens at its two positions must be 2.5 inches apart, to comply with separation distance of the eyes.

When 35mm or 2¼ in. x 2¼ in. pairs are viewed, the two images can be brought close enough without touching so that two corresponding infinity points are 2.5 inches apart. When 2½ in. x 3½ in. or larger photographs are viewed, this is impossible without having some of the picture area overlap unless some optical compensation is inserted in the viewing system. By adding two 8 diopter prisms to an available obsolete optical lens tester, we were able to compress the stereo-pair for visual fusion (Fig. 8). Any "old-time" parlor viwer may be easily converted in this manner to an efficient viewer for 3¼ in. x 4 in. or larger transparencies or prints.

Projecting

Probably the polarization filter method is the most valuable for the medical photographer. By the use of two matched projectors, two polarization filters and viewing glasses,* stereo is easily seen. The prineple of this method is that each eye sees only one image, i.e., the left eye sees the left and the right eye the right projected image. Two projectors are placed side by side, and the stereo slides are focused one at a time on the screen. The projectionist puts on a pair of polarization glasses and a polarizing filter is placed over the lens of the left projector. Then the filter is rotated so that no picture is seen by the right eye. Next, a filter is placed over the right projector lens. This too is rotated until no picture is seen by the left eye. With the viewing glasses removed, the projected images, on a typical 48 in. x 48 in. screen, should be separated horizontally about 1 to 2 inches for corresponding image points. If the separation is correct, by replacing the viewing glasses, a picture in stereo relief should be seen by

* Mfg. by Polaroid Corporation, Cambridge, Mass.

the observer. The polarization filters, after the initial set-up has been tested, can be put into permanent filter holders and attached to the projector lens mount at the determined position.

Mention should be made at this point concerning the two projectors and their alignment. We had available two 3¼ in. x 4 in. *Bausch and Lomb Balopticons* with matched lenses. The magnification was computed for a 48 in. x 48 in. screen in a room of average size. The problem encountered was the time necessary to set the projectors up and put them in alignment for the projection distance needed. After some experimentation, a solution was found by constructing a "stereo-board" (Fig. 9). Some easy means of realigning was needed so that anyone could easily and quickly set up the projectors. This was accomplished by placing wooden blocks in a position to obtain guide slots for the legs of both projectors. With the use of this board, some means of horizontal and vertical adjustment was necessary for alignment of the images. The slide carriers of the projectors furnish the mechanism for sideward adjustment. An easy to manipulate, accurate, and simple gadget for horizontal adjustment was made from a 3/8 in. threaded bolt and nut, a block

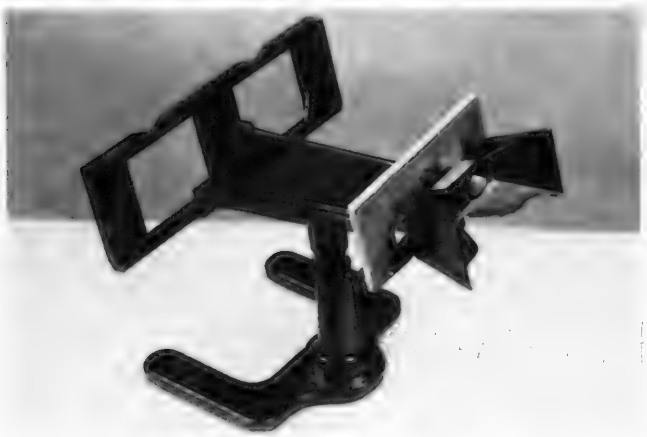

Figure 8. Adapted viewer showing prism holder

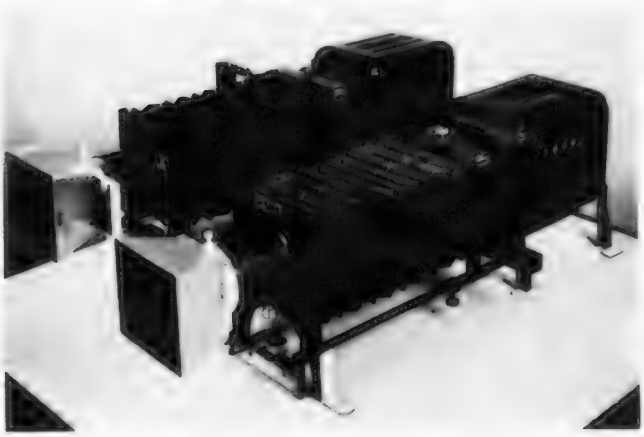

Figure 9. Stereo-board with two matched projectors. Leg blocks to obtain correct alignment, and vertical adjustment screw.

of wood and a small piece of iron. The head of the bolt was cut off and a U-shaped piece of metal welded onto the tip. The diameter of the opening of the "U" was made just wide enough to accept the underside of the front of the projector. The lower end of the bolt was set loosely into a drilled-out piece of wood which was attached to the "stereo-board" between the front legs of the projector. Thus, when the nut was turned, the projector was raised or lowered (Fig. 9). The convergence angle of the projectors and bellows draw is constant.

Projection Screens

Glass-beaded or other ordinary types of screens will not work for stereo projection because the light rays are diffused. The requisite for a stereo screen is that it permit the polarized light rays to remain polarized. There are various commercial screens on the market which fit this requirement but these are quite expensive for a screen of large dimensions. A screen can be constructed quite economically from either plywood or *Masonite*. If plywood is used, more careful surfacing and sanding of the board is necessary prior to painting than with *Masonite*. Aluminum bronze paint, rather than ordinary aluminum paint, is preferable because of its reflectance, smoothness and anti-abrasion qualities. The paint should be sprayed on due to the streaking obtained with brush application. Several coats are recommended with fine sanding between coats.

The Observer's Position

There are two main considerations which should be adhered to by the observer of a projected stereo picture, one being the person's distance from the screen, the other the angle of view. The former can be determined from the following simple formula:

Let

d = focal length of camera lens

f = horizontal width of one of the stereo pair

D = distance of observer from screen

W = width of projected picture

$$\text{Thus, } D = \frac{F \times W}{d}$$

While this answer gives the ideal distance, there is considerable latitude both ways from this point due to the physiological and psychological adjustment of the individual. Nevertheless, if this distance is appreciably increased, a flattened effect will be produced; if greatly decreased, an exaggerated depth is seen. The angle of view is also important because an angle greater than the camera taking angle will produce poor perspective and some light loss.

In conclusion it has been our experience that medical photographers are wary of taking medical pictures in stereo. The justifications for this attitude are numerous. For example, it may be felt that neither the time, nor the money for equipment, are available for experimentation. Or, the photographer may consider the subject too complex, and prefers not to get involved in computations of shift, distance, and other essential factors. However, all such barriers can be put aside if one starts with a simple, basic system, as here presented. The important decision for the photographer to make is whether or not stereophotography can serve a useful purpose in his own institution. If he finds that it can, the means are attainable without undue expenditures of time and money.

REFERENCE

1. Katz, H. F. Orthostereoscopy. J. O[illegible] Soc. Am., Vol. 27, No. 10, Oct. (1937)

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A Simple Preparation of Helminthological Specimens for Photomicrographic Purposes*

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IT is an undisputed fact that photomicrography plays a very important part in the fields of scientific and industrial research. A good photomicrograph should show a maximum of the fine details of the subject and so become as true a reproduction of the original as possible for teaching or demonstration purposes. The start of a good photomicrograph is with the object itself. This means that it should appear as lifelike and undistorted as in a natural state and faithfully represent its morphology and detail.

This article deals with the preparation of small Nematodes as well as larvae and ova of parasitic helminths for photomicrographic purposes. Fixatives commonly used for the preservation of pathological specimens are in the case of small Nematodes, either of very limited, or of no use whatsoever. This does not mean that they will not fix the worms, on the contrary the fixation of small helminths, and especially their larvae and ova is much more rapid than more compact tissue resulting in considerable shrinkage of a part or the whole worm making it virtually useless.

In the absence of helminthological specimens photomicrographs may be satisfactorily substituted provided they are as nearly technically perfect as possible, and truly demonstrate the form of the specimen as it is at the time of recovery from body of the host. The method described in this paper has given excellent results and is such that even small laboratories are able to prepare specimens for photomicrography in a short time and in quite a simple manner.

In detail the process is as follows:

The small Nematodes are removed from the host organs, organic matter, or soil and transferred to a small beaker containing isotonic saline solution (0.9% NaCl) which is kept agitated gently in order to achieve a relaxation of the worms. After the Nematodes have been freed of all adhering mucus, soil, or fecal matter they are transferred into a small *Pyrex* beaker containing approximately 10 ml. of saline solution. The following solution, heated to 60C is then poured into the beaker:

Isotonic saline solution	100 ml
Absolute alcohol	30 ml
Formalin 40%	1.5 ml
Glacial acetic acid	1 ml

(This fixative keeps indefinitely.)

The worms may remain in this fixative practically indefinitely, without any noticeable change in their form or structure. For the best results however the preparation of the worms for photomicrography is carried out as soon a

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Figure 1. A female specimen of Enterobius vermicularis (the human pinworm) obtained from the appendix of a child and mounted directly in saline and Lugol's iodine solution. 250X

Figure 2. Anterior end of a female specimen of Syphacia obvelata a roundworm commonly found in the cecum of mice and rats. The specimen has been fixed and stained by the method described in the article. 150X.

fixation is completed, after approximately half to one hour. The fixative is then poured off and the worms washed gently for 20 minutes under a cold water tap.

After washing, part of the water is poured off and to the remainder (about 10ml) 10 drops of Lugol's iodine solution* are added. The beaker is kept agitated.

Soon a change in the colour of the worms becomes visible. This is at first slightly yellowish becoming dark brown. A properly stained specimen should be very light brown in colour and fully transparent when viewed under the microscope. The internal organs should be distinguishable with ease.

After staining is completed the organisms are carefully transferred to a clean slide, covered with a number 1 coverslip and sealed round with wax or glycerine jelly.

Lugol's iodine solution is made as follows:

Iodine	1 g
Potassium Iodide	2 g
Distilled water	100 ml

Figure 3. A lateral view of two male specimen of Syphacia obvelate. 150X

It should be noted that there is no other mounting medium into which the worms are transferred, only the water containing the iodine is used. Care should be taken to cover the worms sufficiently to avoid any bubbles

Figure 4. Eggs of Enterobius vermicularis mounted directly in saline and Lugol's iodine. 500X.

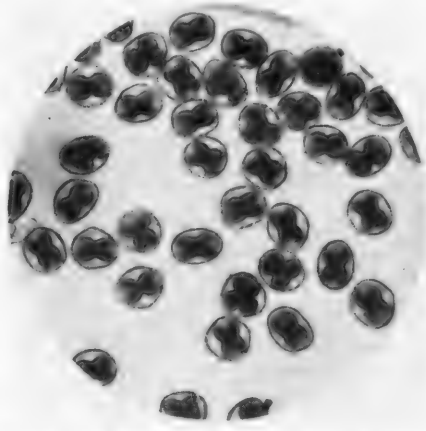

Figure 5. Eggs of Toxocara cati, a round worm commonly found in the small intestine of cats, showing different stages of segmentation. Mounted in saline and Lugol's iodine 250X

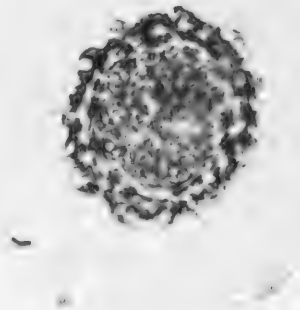

Figure 6. Egg of Ascaris lumbricoides (the giant intestinal roundworm), mounted in saline and Lugol's iodine. 750X.

Figure 7. Embryonated egg of Hymenolepis diminuta (the rat tape worm) showing hooklets. Specimen mounted directly in saline and Lugol's iodine 750X

The writer thinks it is important to mention the fact that the right technique in staining can only be achieved by trial but once mastered it rewards the user with crisp and clear photomicrographs which are surely worth that little bit of trouble

To make an iodine preparation of larvae and ova of any helminth is a very simple proce

A small amount of material is mixed on a slide with 1 drop of saline and 1 drop of Lugol's iodine solution

The preparation is then covered with a cover slip and sealed round with paraffin wax or glycerine jelly

Any ova present will show as clear and sharply defined shells with evenly

Figure 8 Egg of human blood fluke (Schistosoma mansoni) showing the lateral spike and miracidium inside the egg. Direct saline iodine preparation. 500X.

Figure 9. Egg of Hookworm showing larva inside the shell. Specimen mounted directly in saline and Lugol's iodine. 750X.

brownish stained nuclei or embryos inside the egg. Larvae, which appear brownish in colour, are best photographed as soon as possible as there is a danger of decomposition.

If desired the latter process can also be used for mounting whole small Nematodes. These are transferred with all adherent organic matter to a slide, two drops of saline and one drop of Lugol's iodine are added and the whole preparation covered with a coverslip and sealed round with paraffin-wax or glycerin jelly.

The actual photomicrographic technique is carried out in the usual manner dependent on the apparatus or instrument used. In the writer's experience the best results are obtained by using orthochromatic material with a light green filter. For large worms the best objective is a two inch one (50mm) with a 10X eyepiece, whilst for larvae and ova, as well as for parts of larger Nematodes, the 2/3 in. (16mm) objective and 5X eyepiece are quite sufficient. If it is desired, however, to obtain a larger magnification of a single ova or larva a 1/6 in. (4mm) or better still a 1/7 in. (sic) (2mm) oil immersion objective with the appropriate eyepiece gives excellent results provided that the lighting and the actual specimen have been adjusted and made with the utmost care.

With regards to the exposure, no data can be given as this depends on the optical system, filter factor and brightness of the actual microscopic field. Every photomicrographer knows the possibilities and limitations of his equipment and the exposure should not be difficult to calculate.

I should like to thank Dr. G. B. Manning for his kind permission to carry out the work connected with this paper as well as for his great assistance in obtaining some of the specimens from which the accompanying photomicrographs have been made. Photomicrographs 1, 4, 5, 6, 7 and 9 were taken with a *Watson* vertical micro-camera and photomicrographs 2, 3, and 8 with the V *P. Exacta* using a photomicrography attachment.

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The Use of Cine Extension Tubes for Cinematography of Small Objects*

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SERIOUS workers in the 16mm field have long recognized the possibilities for the use of extension tubes in motion picture work. Minute objects, such as parasites, details of a butterfly wing or the head of a fly, can be placed very close to the camera while being kept in focus and magnifications are obtainable up to thirty diameters greater than with the unextended lens.

As biological photographers generally know there are many situations where objects are too small to be adequately handled by the full extension of the average lens mount and yet too large to be photographed under the microscope. Unless some especially constructed camera or adaptation for macroscopic work is available, this "no man's land" is a constant challenge or a constant headache.

Extension tubes can be most helpful, providing they are well designed and made to close tolerances. Several manufacturers of motion picture equipment have at various times, made and catalogued first-rate extension tubes; various types and specifications. However, the demand is limited and in small quantity production the prices are higher than the user can, or is willing to pay. Thus, the item is labeled "uneconomical" and discontinued. When they have been available they usually have been offered in only one or two sizes, limiting their flexibility and application. The writer has had many inquiries about movie making of small objects and has endeavored to answer each in detail. Since there appears to be a general need for this information this paper was prepared to cover the essentials of the subject.

Tube and Ring Dimensions

As all of the inquiries we have received refer to cameras which accommodate the "C-mount" lens, the extension tubes described are designed for this type. Four extension tubes and three extension rings are needed. They allow extensions as great as 1¾ inches. An extremely flexible set which will accommodate all of the lenses commonly used consists of three rings each .05 inch long, two short tubes .20 inch long, one medium tube .40 inch long, and one long tube .80 inch long. Any of the extensions called for in the accompanying table can be obtained by suitably combining these tubes and rings.

In using the table it is only necessary that you know the size of the object to be photographed. The table will then show the proper extension in inches for this object, as well as the

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A set of extension rings as described in text. Sizes are indicated on the illustration.

proper object-to-film distance. Also given in the table is the magnification obtained on the film. The magnification on the screen when projecting the film will be many times greater.

Obtaining Sharp Focus

As in ordinary photography, the depth of field is increased by stopping the lens down, and it is thus desirable to light the object well so that as small an aperture as possible can be used.

The table shows the proper distance for sharp focus provided the actual lens focal length is close to its nominal value, something not always the case. Though a formula is given at the end of this paper which can be used to compute the proper object-to-film distance for any lens focal length in addition to those in the table, it is desirable to focus visually if this is provided for in the camera or if a device such as a reflex focuser is available.

Exposure

The brightness of the image on the film is reduced when the magnification is increased, and this should be compensated for by increasing the lens aperture (or decreasing the camera frame speed) at larger magnifications. The required exposure increases are as follows:

Magnification	Required Additional Exposure (f-stops)
1.0	1
1.25	1 1/3
1.5	1 2/3
1.667	2
1.50	2 1/3
2.000	2 2/3
2.333	3

How to Use the Table

Select the size of the field to be photographed from the table. Normally, a field size at least 50% and preferably

Extension rings in use on a 16mm magazine loading camera. Here the total extension of 1.75 inches, in combination with a 1-inch lens, gives a field size of .16 inch by .22 inch.

70% larger than the object should be selected so that the object will not extend out to the very edge of the frame. When the field size is located in the table, read up to find the lens focal length necessary and read to the left to find the required extension in inches. Just to the right of the field size in the table will be found the proper object-to-film plane distance for the lens and extension tube combination. *Important:* The lens must be set at infinity unless focusing visually. If the magnification exceeds .20, use the table in the foregoing section to provide the proper increase in exposure.

Examples of Use

Example 1

Assume that the object to be photographed measures 1 inch high by 2 inches wide. Multiply these dimensions by 1.7 to obtain 1.7 x 3.4. Look in the table for the smallest field size in which these dimensions will fit. This is 2.84 x 3.8, using a 2 inch lens. The extension tube length (reading to the left) is .200 and the distance from the object to the camera film plane (reading to the right) should be 24.2 inches. The magnification is .100, meaning that the image on the film is one-tenth the linear dimensions of the object. This low magnification requires no exposure increase.

Example 2

Assume the object measures .25 inch in diameter. Multiplied by 1.7 this becomes .425, and will fit in a field size of .47 x .63 although .41 x .54 might also be selected. A one inch lens and .60 inch extension would be used (the medium length .40 inch tube and the small .20 inch tube used together). The object-to-film distance is 4.27 inches and the magnification is .60. At this magnification slightly more than a one stop increase in exposure is required over that indicated by the exposure meter.

Equations Used For The Table

The thin lens formula was used, i.e.

$$\frac{1}{F} = \frac{1}{U} + \frac{1}{V}$$

where:

F = lens effective focal length
U = distance from object to lens
V = distance from lens to image

The equations used for the table are as follow

1. Magnification: $M = \frac{S}{F}$

3. Distance: $(S + F)$

4. Field Height: $\frac{.24}{M}$

Field Width: $\frac{.}{M}$

where:

S = extension tube length
F = lens effective focal length
M = magnification

Field height and width are based on standard 16mm motion picture projection: projector aperture .284 in. high by .380 in. wide.

TABLE OF SIZES, DISTANCES, AND MAGNIFICATIONS WITH EXTENSION TUBES

Extension (inches)	Field (height)	Field (width)	Object-to-Film Distance (inches)	Magnification (factor)
(0.7 Inch Focal Length)				
.05	4.00	5.35	11.25	.071
.20	.99	1.33	4.05	.285
.25	.80	1.06	3.61	.357
.30	.66	.89	3.33	.429
.40	.50	.67	3.02	.571
.50	.40	.53	2.88	.714
.60	.33	.44	2.82	.857
.70	.28	.38	2.80	1.00
.80	.25	.33	2.81	1.14
.90	.22	.29	2.84	1.29
1.00	.20	.27	2.89	1.43
1.20	.17	.22	3.01	1.71
1.40	.14	.19	3.15	2.00
1.60	.12	.17	3.31	2.29
1.75	.11	.15	3.43	2.50
(1.0 Inch Focal Length)				
.05	5.68	7.60	22.05	.05
.20	1.42	1.90	7.20	.20
.25	1.14	1.52	6.25	.25
.30	.95	1.27	5.63	.30
.40	.71	.95	4.90	.40
.50	.57	.76	4.50	.50
.60	.47	.63	4.27	.60
.70	.41	.54	4.13	.70
.80	.36	.47	4.05	.80
.90	.32	.42	4.01	.90
1.00	.28	.38	4.00	1.00
1.20	.24	.32	4.03	1.20
1.40	.20	.27	4.11	1.40
1.60	.18	.24	4.23	1.60
1.75	.16	.22	4.32	1.75
(2.0 Inch Focal Length				
.05	11.36	15.20	84.05	.025
.20	2.84	3.80	24.20	.100
.25	2.27	3.04	20.25	.125
.30	1.89	2.53	17.63	.150
.40	1.42	1.90	14.40	.20
.50	1.14	1.52	12.50	.25
.60	.95	1.27	11.27	.30
.70	.81	1.08	10.41	.35
.80	.71	.95	9.80	.40
.90	.63	.84	9.34	.45
1.00	.57	.76	9.00	.50
1.20	.47	.63	8.53	.60
1.40	.40	.54	8.26	.70
1.60	.35	.47	8.10	.80
1.75	.32	.43	8.04	.87

(3.0 Inch Focal Length)

.05	17.00	22.75	186.05	.0167
.20	4.24	5.67	51.20	.067
.25	3.42	4.57	42.25	.083
.30	2.84	3.80	36.30	.100
.40	2.13	2.85	28.90	.133
.50	1.70	2.75	24.50	.167
.60	1.42	1.90	21.60	.200
.70	1.22	1.63	19.56	.233
.80	1.06	1.42	18.05	.267
.90	.95	1.27	16.90	.30
1.00	.86	1.15	16.00	.33
1.20	.71	.95	14.70	.40
1.40	.61	.81	13.83	.47
1.60	.54	.72	13.23	.53
1.75	.49	.66	12.89	.58

(4.0 Inch Focal Length)

.05	22.71	30.40	328.05	.0125
.20	5.68	7.60	88.20	.050
.25	4.58	6.13	72.25	.062
.30	3.79	5.07	61.63	.075
.40	2.84	3.80	48.40	.100
.50	2.27	3.04	40.50	.125
.60	1.89	2.53	35.27	.150
.70	1.62	2.17	31.56	.175
.80	1.42	1.90	28.80	.200
.90	1.26	1.69	26.68	.225
1.00	1.14	1.52	25.00	.250
1.20	.95	1.27	22.53	.300
1.40	.81	1.09	20.83	.350
1.60	.71	.95	19.60	.400
1.75	.64	.86	18.89	.44

(6.0 Inch Focal Length)

.05	34.21	45.78	732.05	.0083
.20	8.53	11.41	192.20	.0333
.25	6.82	9.13	156.25	.0416
.30	5.68	7.60	132.30	.050
.40	4.24	5.67	102.40	.067
.50	3.42	4.58	84.50	.083
.60	2.84	3.80	72.60	.100
.70	2.43	3.25	64.13	.117
.80	2.13	2.85	57.80	.133
.90	1.89	2.53	52.90	.150
1.00	1.70	2.28	49.00	.167
1.20	1.42	1.90	43.20	.200
1.40	1.22	1.63	39.11	.233
1.60	1.06	1.42	36.10	.267
1.75	.98	1.31	34.32	.291

Editor's Note: The author will be glad to furnish any supplementary information on the subject discussed. Write directly to Mr. Mervin W. La Rue, 159 East Chicago Avenue, Chicago 11, Illinois; not the Editor

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Differential Optical Staining of Colorless Living Organisms in Macro-Photography*

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OPTICAL staining or color contrast method for microscopic examination date back to the late nineteenth century. In 1896 Rheinberg introduced his color contrast method. Briefly, this consisted of a double ring filter with a blue center and a red periphery. When this combination filter was placed under the microscope condenser, it produced a blue field as a result of the transmitted light — a bright field effect — while organisms such as protozoa appeared red as a result of the refracted light — the dark ground effect. This method has its merits, but is only capable of producing a single color in the organism under examination.

After Rheinberg, other methods were devised to study unstained specimens. The most important of these are dispersion staining[1], phase contrast[1], color schlieren[2], recently the interference microscope[3]. Of the four, all except the standard phase contrast miscroscope are capable of differentially staining colorless object.

The purpose of this paper is to present a method of differential optical staining which will extend its use into the field of macro-photography, and which employs a standard and proper macro-photographic apparatus; i.e., one consisting of double condensing lenses in a focusing and decenterable mount. In addition to this, three light sources and four filters, red, green, blue and yellow are required. For purposes of illustration the light sources are designated I, II and III, and the filters A, B, C, and D.

Figure (1) shows the arrangement of light source (I) with its filters A (blue) and B (green). The filters are arranged in front of the light source condensing lens in such a way as to equally divide its field with their respective colors. Placed at this point of division is an opaque spacer 5mm wide. As this spacer serves to split light source (I) into three bands: blue, green and black, it is necessary for it to be perfectly centered.

Figure (2) illustrates the relationship of light source (I) to the optical system. With the system thus arranged, the specimen and its surrounding field will merely appear in divided color. However, if condenser 2 is displaced laterally, varying degrees and combinations of the two colors may be achieved in the specimen, with the background ranging from blue and blue green to black, depending upon the amount of lateral displacement. With the system arranged in this manner, light sources (II) and

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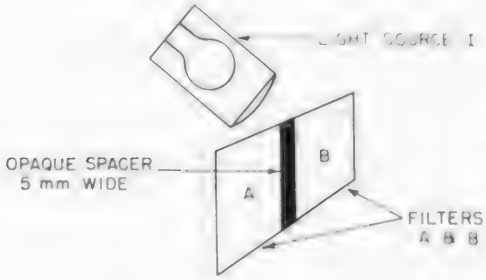


Figure 1. Arrangement of light source with its blue and green filters (A) and (B), respectively.

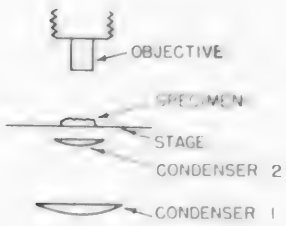
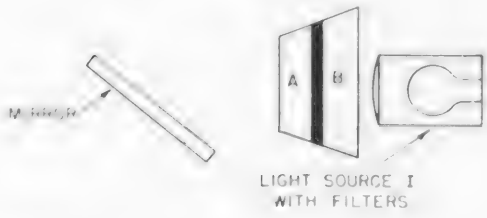


Figure 2. Relationship of main light source to optical system.



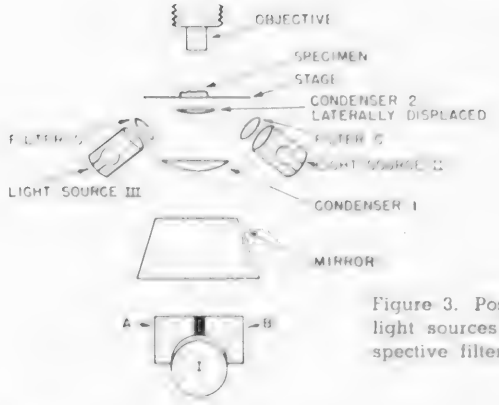


Figure 3. Positioning of supplementary light sources II and III with their respective filters (C) and (D)

(III) and filters C and D are introduced. Figure (3) shows the placement of these elements. Light sources (II) and (III) with their respective filters C and D are placed at 45° to the optical axis, and their light pencils are focused through condenser 2 to the plane of the specimen. If the specimen is now viewed on the ground glass, it will appear brilliantly illuminated in the four colors and their combinations. By simple manipulation of condenser 2 and light

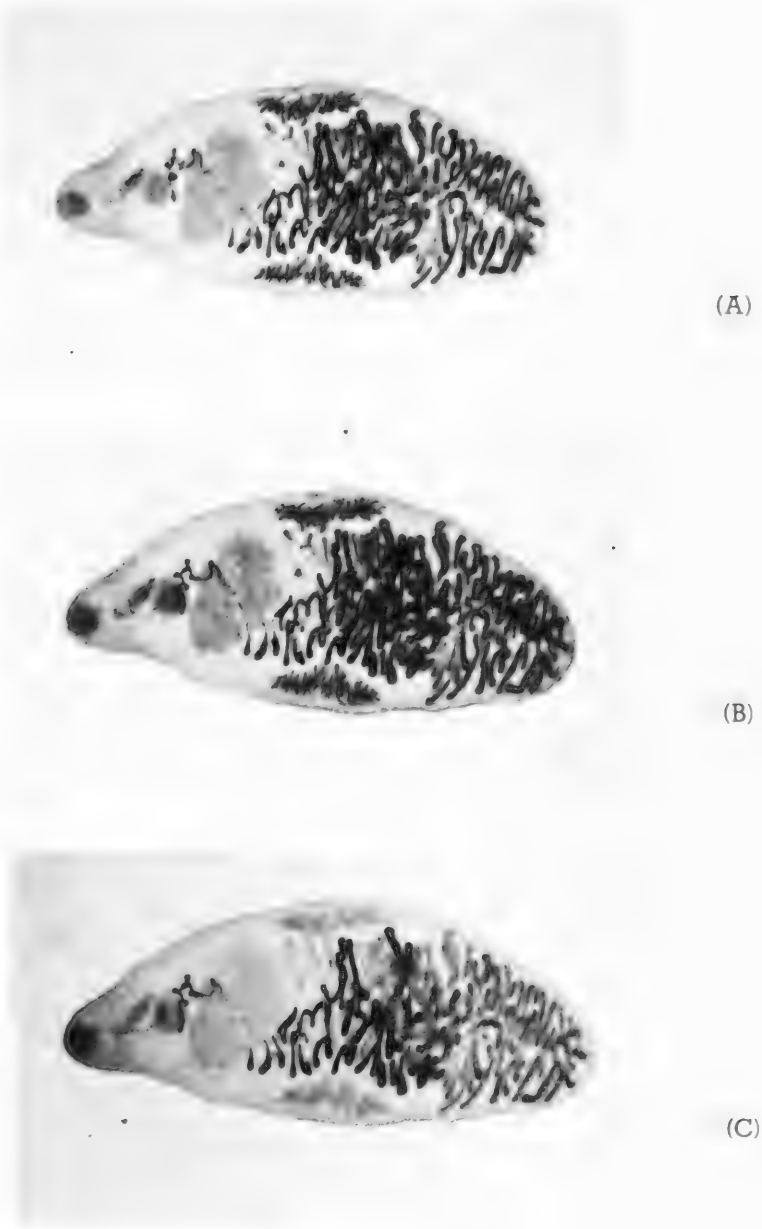


Figure 4(A). Liver fluke, straight transmitted light; (B) organism optically stained red; (C)

(D)

(E)

multiple coloration; (D) variation of multiple coloration; (E) multiply stained, dark background
All illustrations 25X of live specimens in saline.

sources (II) and (III) the organism to be photographed may be diffentially stained. The areas and degree of color saturation will depend upon and vary with the adjustment of these elements.

Figures (4A-4E) illustrate various staining possibilities using the system described. The photographs were made on *Kodak Type B Ektachrome* 4 in. x 5 in. sheet film. However, any color medium may be used in either roll or sheet form. By deviating post-mortem artefacts, the technique permits the recording of detail which are often lost or obscured when organisms are subjected to chemical fixation and staining.

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Color Photography of Fluorescent Plant Materials

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Introduction

COLOR photography is an excellent means for recording fluorescent phenomena. My use of this technique arises from interests in fluorescent conditions associated with physiological disorders in vegetable crops[1] where fluorescence can aid in diagnosis and study. In attempts to employ the methods of fluorescence photography suggested in the literature, the colors of fluorescing objects did not reproduce with sufficient fidelity, as experienced by others.[2]

Rieger and March[3], in a general review on fluorescence photography in color, describe a number of variations in applying the technique. In the method described here we are concerned only with the photomacrography of visible fluorescence induced by long-wavelength ultraviolet radiation. The technique consists of providing an ultraviolet source to induce fluorescence in the objects and a filter at the camera to absorb the reflected ultraviolet while the visible fluorescence is transmitted to the film. This basic technique has been applied in color photomicrography where the ultraviolet beam may be either reflected or transmitted, depending upon the type of microscope used[4,5,6,7,8,9]. The technique has also been employed in photomacrography[5,10,11,12,13].

The primary objective in making color photographs of fluorescence is to reproduce as nearly as possible what the observer sees, particularly with respect to color. Careful consideration of all factors is essential.

General Setup

Photomacrographs of fluorescent objects must be taken in a dark or almost wholly darkened room. Sixty-cycle current should be available as most mercury lamp equipment is designed for this frequency. The location in which the equipment is used should be as free of vibrations as possible. A convenient holder for the camera is a rigid stand with an adjustable arm to which the camera is attached with its optical axis vertical (Figure 1). The stand in my setup is at the edge of a large light box with a ground plate glass cover; beneath the glass are incandescent background lights used to eliminate shadows in conventional black-and-white photographs. Since mercury lamps give off considerable heat, the room should be well ventilated, and a fan may be necessary to keep the material cool.

Source of Ultraviolet

Medium-pressure mercury vapor lamps are a convenient source of radiation rich in the near ultraviolet, especially at the 3650-63A lines. They have the advantages of operating in any position, starting easily, and not fluctuating in intensity. In my setup four lamps (obtain-

Figure 1. Four-lamp ultraviolet setup.

able from either Westinghouse Electric Corp., Bloomfield, N. J. or General Electric, Cleveland, Ohio) are used to give an intense and fairly even irradiation. Two large fixtures, one with an H250-A5 lamp and the other with an H400-E1 lamp, are at the sides of the camera in the east and west positions, respectively. One fixture with an H100-FL4 lamp is at the north position and another at the south (Figure 1). The radiation generated by the mercury arcs is controlled by placing a roundel glass filter across the reflector opening or over the bulb, depending upon how the lamp is mounted in the fixture. The small fixtures require 5-inch filters and the larger fixtures 12-inch filters. The fixtures are directed at the photographic field with an aiming angle of 45°. This angle is selected as the standard angle for fluorescence photomacrography on the basis of De Ment's[34] discussion. He pointed out that observation of fluorescence should be made at 45° to the incident irradiation to avoid errors due to possible lack of spherical symmetry. The fixtures are placed as close to the field as possible without their reflected images showing in the pictures. In my situation the length of the beam axis is 14 inches for the large fixtures and 10 inches for the small fixtures. It is desirable that the fixtures be suspended from the ceiling in a manner that will permit them to be moved out of position easily. This is especially desirable for the two side fixtures so that they can be exchanged with photofloods for conventional color photography. The use of the H400-E1 lamp to increase the intensity somewhat instead of another H250-A5 lamp does not appear to offer a significant advantage. In reference to lamp housings with roundel filters, those with concave reflectors behind the lamp appear to give better distribution of the radiation for photography than those that have reflectors in the form of a half cylinder with the lamp mounted at right angles to the beam axis. A principal consideration in selecting a set of mercury lamps for photography is the size of the photographic field to be illuminated. A field about 9 inches in diameter, for example, could be suitably irradiated by a set of four H100-FL4 lamp fixtures placed 10 inches from the center of the field with an aiming angle of 45°.

Ultraviolet-transmitting Filters

In selecting a system of filters, any system that is mutually exclusive could be used to photograph the fluorescence that exceeds the exciting wavelengths. One filter would transmit in a shorter wavelength region over the source and the other in a longer wavelength region in front of the camera lens. Here we are concerned only with filters over the source that provide peak transmission at about the 3650A line and that are essentially opaque from about 4000A through the visible.

The ultraviolet-transmitting filters that are suitable for use in close proximity to medium-pressure mercury arcs are those able to withstand thermal shock

The temperature, for example, of the lens of the H100-FL4 lamp when operated in a room temperature of about 24C is 280C (horizontal position), 293C (base up position), and 343C (base down position). The filters used should withstand elevation to temperatures of this general magnitude in a few minutes.

The ultraviolet-transmitting filters should absorb all incident visible radiation from the source so that the hue of the fluorescence may be accurately perceived. If any visible radiation is admitted to the scene, it should be at a much lower level than the fluorescence. Misconceptions of the hue of the fluorescence are easily obtained if the incident irradiation contains much energy in the violet, blue or red regions; these regions are transmitted by the more open ultraviolet filters. Reflected visible radiation may be misinterpreted for fluorescence and it tends to obscure any feeble fluorescence. It is especially bothersome when one is attempting to distinguish the red fluorescence of chlorophyll-containing plant parts and the violet, blue, and red components of the radiation on the object. The open nature of some ultraviolet transmitting filters in the red is of some consequence since medium-pressure mercury lamps emit a slight amount of red at the 6907A line. Transmission characteristics in the violet are very significant because of the moderately strong emission in the 4047-78A region. Although the use of more open filters would contribute much to image brightness, one could not consider the image to represent only visible fluorescence.

The best heat-resisting filters of the denser, less open type that are available at present are *Kopp No. 51* (Kopp Glass Inc., Swissvale, Pa.) and *Corning No. 5874* (Corning Glass Works, Corning, N.Y.). The former, however, is the less open of the two. This is evident from visual inspection and from technical information provided by the manufacturers. A *Kopp No. 51* filter, 4.37mm thick, transmits 45% at 3600A and 12.5% at 7400A* whereas *Corning No. 5874* (Color spec. 7-39), 4.9-5.1mm thick, transmits 54% and 28% at approximately the corresponding wavelengths. The *Corning* filter transmits more of the strong mercury arc lines in the 4047-78A region and for this reason it is not considered as desirable for color photography as *Kopp No. 51*. Even when this dense a filter is employed with the mercury arc, the following is seen by a dark-adapted eye: 2650-63A (fairly bright for some observers); 4047A (violet - relatively bright); 4358A (blue - very weak); 5461A (yellow-green - weak) 5770-90A (yellow-orange - very weak). There is also some slight red mainly at the 6907A line.

The sensation resulting from the above is interpreted by an average observer to be a deep violet because of the dominant intensity of the 4047A line. The possible effect that this may have on color rendition in the transparencies is considered further in the section on ultraviolet-absorbing filters.

The *Kopp* filters examined (two 12-inch squares, four 5-inch squares and one "rectangular" piece, 4.37mm thick) appeared to the eye very uniform in transmission characteristics.

The Object and Background

It is generally necessary to immobilize plant materials during exposure periods exceeding a few minutes. Water loss and consequent wilting often result in

*These data were obtained in our laboratory with a *Beckman* quartz spectrophotometer, *Model DU*, using a tungsten lamp and photomultiplier tube No. IP28. The readings were made on a *Westinghouse* DC microvolter, *Type PX5*. This confirms data provided by Kopp Glass, Inc. on Feb. 23, 195[illegible]

gross movements, especially in leafy materials. This may be minimized by taping the object down. To prevent cut surfaces from drying out during the exposure, it is helpful to coat them with a thin layer of humectant such as glycerine. Any other nonfluorescent humectant that does not alter the fluorescence of the specimen significantly may be suitable. A layer of *Saran* plastic film (Dow Chemical Co., Midland, Mich.) was found very effective in preventing the drying of smooth, cut surfaces, such as those of a cut potato. It also retards the development of oxidative color changes during the period of the exposure. Though the use of glycerine or *Saran* must have a slight effect on the appearance characteristics of the freshly cut surface, the effect is not very noticeable in photographs. With either method, but especially when *Saran* is used, the material appears much fresher in color transparencies than when no measures are taken to prevent drying or color changes. If *Saran* is used on cut surfaces that are photographed by conventional methods, specular reflections from the surface into the camera must be avoided.

Brightly fluorescing objects should not be photographed with weakly fluorescing objects. If objects differing widely in intensity are photographed together, it is necessary to place an opaque barrier between them, or space them widely apart, to prevent the fluorescence of one from noticeably illuminating the other.

In selecting a background, its appearance under visible and ultraviolet radiation should be examined; a strongly fluorescent background is generally not desirable, mainly because it will illuminate the sides of an object. A textured background such as velvet effectively obscures any shadows the object may cast and any unevenness in the illumination of the field. With respect to color and lightness, the background should, in general, contrast with the object, and especially with its edge. Black velveteen is very suitable with brightly fluorescing objects, whereas white velveteen or white *Orlon* fleece is satisfactory with dark objects. The use of either colored or black velvet backgrounds tends to obscure the effect of more open filters employed at the source or of incorrect filter combinations used at the camera. The thick, frosted plate glass cover of the light box I use has proved very suitable and convenient as a background for many objects (Figure 2, 3). When necessary, objects can be taped to it and need not be moved if it is desirable to photograph them also in color by conventional methods or in black and white. Since the ground plate glass background appears nearly neutral in color under ultraviolet radiation, its use is especially desirable for subsequent evaluation of transparencies to see if the film color balance is unduly influenced by the various filters tested at the camera. Different glasses may appear suitable for this application, yet when viewed under ultraviolet, they may show considerable variation in hue. This is mainly due to differences in fluorescence. In selecting a background glass it should be tested under ultraviolet in advance.

Ultraviolet-absorbing Filters

The *Wratten 2A* and more recently the *2B* ultraviolet-absorbing filters have been used in much previous work. Peterson and Gibson[13] used two *Wratten 2B* filters with *Kodak Color Compensating* filters *CC-10R and CC-10Y*. They also used a *CC-10M* to prevent excessive recording of a greenish fluorescence of the object. Their source filter was provided by the lamp itself, a 100-watt B-H4 mercury lamp (recently designated the

H100-BL4) which has an outer bulb 1mm thick of ultraviolet-transmitting glass (*Corning No. 5874*). Their filter system when tested with my source, which provides less visible radiation, renders objects much too blue. Peterson and Gibson state that when the object is laid directly on the background, the latter sometimes records as a blotchy blue. This would indicate the insufficient correction or, less likely, that their background fluoresced blue. My tests show that one *Wratten 2B* filter effectively cuts out the ultraviolet. Two such filters only increase the exposure time without adequately reducing transmittance in the violet, blue, and green. The *Wratten 85* filter has been employed alone[3] with *Kodachrome, Type A* film. Since *Type A* film is especially sensitive to blue, and since my tests indicated that the *Wratten 85* filter transmits too much blue, it appears that this system is not sufficiently corrected.

A number of ultraviolet absorbing filters were tested photographically. They are arranged below in four groups according to the nature and/or severity of their principal defects:

Group 1 — Cut off high, around 4500-4700A, shifting balance of transparencies toward green. (*Wratten 4, 8, 9,* and *Corning Noviol Shade B, 3-72, 2.0mm*)

Group 2 — Cut off low, around 3800-3900A, and/or transmit too much violet, blue, and green. (*Wratten 2B* and *Fish Schurman Interference Film D-A1* at angle of 45°)

Group 3 — Transmit some ultraviolet. (*Wratten 86, 86A,* and *Corning Noviol Shade 0, 3-75, 2.0mm*). The transmitted ultraviolet is especially noticeable in transparencies, where it records as blue specular reflections on smooth, curved objects.

Group 4 — Transmit a slight excess of blue and green. (*Wratten 85* and *85B*).

The filters in Group 4 are the most promising. When tested photographically under my conditions, they showed no transmittance of the ultraviolet. Visual tests for ultraviolet transmittance, made by inserting the filters between an H100-A4 source with a *Corning 5860* filter (color spec. 7-37) and a *Corning 3750* fluorescent canary filter, gave negative results.

A satisfactory ultraviolet-absorbing filter should not be fluorescent itself under ultraviolet radiation. Although both filters in Group 4 fluoresce, the intensity appears noticeably less than that of the *Wratten 2B*. *Wratten 85* and *85B* filters were tested further in combination with *Kodak Color Compensating* filters to adjust the color balance satisfactorily. Published information[15] on the spectral transmittance characteristics of the filters was helpful in making a selection. Numerous combinations were tested photographically with a variety of fluorescent plant materials. Evaluation of resultant transparencies was based not only on the rendition of test objects but, as recommended earlier, also on the rendition of the ground plate glass background. Minor variations in the combinations of filters tested could be noticed easily in the transparencies. Attempts to correct the *Wratten 85B* gave unsatisfactory results, one of the most noticeable defects being too reddish a reproduction. The following filter combination gave good results (Figure 3) with objects requiring long exposures of from forty minutes to one hour: *Wratten 85*, plus one each *Kodak CC-30R CC-10Y*, and *CC-10M* filters.

Figure 2. Celery petiole: boron deficiency symptoms. Photograph taken with visible illumination.

Figure 3. Celery petiole: ultraviolet irradiated, showing advanced B deficiency.

The order as given indicates the position of each filter in the combination. The ultraviolet-absorbing component is in front to protect the others from ultraviolet radiation, which would cause them to fade and also to fluoresce.

In arriving at the most satisfactory combination of filters, one criterion was to obtain transparencies that closely resembled the photographic field as interpreted visually by the observer. The field reflects some visible radiation, due to some light from the mercury arc being transmitted by the source filter. Though relatively weak, it must have some effect on the color film. Fortunately the filter combination at the camera absorbs fairly strongly the four principal mercury lines, and so their effect is diminished. Any attempt to eliminate their effect, thereby altering the transparency image from that observed in the original photographic field, would necessitate filters with much narrower absorption bands than those of the color compensating filters employed.

The Camera, Film and Exposure Time

The camera used in this work was an *Eastman Kodak Crown Graphic* with an *Ektar* 127mm, f/4.7 lens. All exposures were taken at the maximum aperture to keep exposure times within forty minutes to one hour. A lens of a larger maximum aperture would be advantageous. The best position for the ultraviolet absorbing filter is just in front of the lens, where it has the least effect on the direction of the rays. Also, should any of the lens component fluoresce in ultraviolet, the filter would prevent it.

None of the color films presently available can be considered correctly balanced for fluorescence color photography. *Ektachrome, Daylight Type* was used because it is relatively less sensitive to blue than *Type B* film. Its use is appropriate in this technique where the ultraviolet-absorbing filter (uncorrected) used at the camera lens does not absorb sufficiently in the blue.

Hirt[1], Ellinger[2], and Lowenstein[7] used

corresponding to the color film they used as a means of approximating the exposure time. Royer, Maresh, and Harding[2] and Royer and Maresh[3] describe a photoelectric method for estimating fluorescence intensity. An object that fluoresced evenly over the entire field was used to obtain at the ground glass a standard galvanometer reading. To determine the correct exposure, trial exposures were then made of subjects that fluoresced in the same range of intensity as the test object. Peterson and Gibson[13] took direct meter readings of brightly fluorescing object after placing the filter elements used at the camera in front of the photoelectric element. They also describe an "extinction" method of estimating the exposure by noting the aperture of the lens at which the fluorescing areas become distinctly traceable on the ground glass as the diaphragm is progressively opened. In my work exposure is estimated by exposing a film in geometric steps, double the time of the preceding one. If a single fluorescent characteristic of an object is of primary interest, the exposure time can be selected for it. In routine work, however, it is best to time the exposure so that the weakly fluorescing areas are well recorded. The object then becomes better defined as a whole. This subject is considered further in a later section.

With my setup very intensely fluorescing objects (tests pieces of colored fluorescent papers) require 5-20 seconds exposure, whereas, weakly fluorescing objects (many plant materials) require about forty minutes to one hour. The ultraviolet-absorbing filter combination suggested here was determined on the basis of the longer exposures. The filters can be cemented together in "B" glass. This increases the transmittance of the combination and reduces exposure time somewhat. *Ektachrome* film appears to respond satisfactorily to fairly long exposure times. No attempt was made to evaluate the reciprocity failure characteristics of the film, but the failure that undoubtedly occurs at these long times is corrected in part by the lens filters.

The Photograph Situation and Fluorescent Scene

The fluorescing object and background are unique as compared with situations commonly encountered in color photography. Though visible radiation from the source is largely eliminated, the very small amount reflected from the field, plus the fluorescence that the field exhibits, may give the impression of moderate brightness in that area. The surroundings are very dimly illuminated from this source and from scattered ultraviolet which may induce some perceptible fluorescence. Thus, the peripheral regions of the room are very dimly illuminated, but they appear relatively dark to the observer.

Some of the attributes and effects seen in a self-luminous object and in a fluorescent photographic scene present quite a different appearance than when they are observed under an external source of illumination. The fluorescent glow of the object is often very impressive. The object is, in fact, a primary light source or an illuminant. To the observer the color seen is an example of the illuminant mode of appearance[16]. Another aspect of the object is that its seemingly non-fluorescent portions appear dull and opaque. This is because there is little reflected visible radiation present; the small amount that is admitted to the scene by the filter over the source is insufficient to give any impression of specular reflections that are either noticeable visually or that are recorded photographically. Yet, one is aware of it

The source of the fluorescence in the object is of special importance in photography: the precise locus of origin relates primarily to the extent to which the exciting radiation penetrates the object. With opaque specimens the fluorescence is quite superficial in origin, whereas with more transparent specimens, the fluorescence may arise at deeper levels. In the latter case, multiple reflections (and absorption) occur within the object, and, to the extent to which this radiation is emitted to the outside, the object appears luminous within. Whether superficial or deep-seated in origin, but especially with the latter, the fluorescence may illuminate other relatively nonluminous portions of the object. Though such effects are usually quite localized, areas thus illuminated are tinted with the hue of the fluorescence, and there is a consequent loss in contrast between surface details. An aspect of the photographic scene that is very evident in the transparencies is that the object lacks shadows or, if shadows are present, they are not very noticeable or sharply defined. When several objects are placed close together, they may prevent the background that shows between them from recording as strongly as at the periphery of the field.

Viewing and Evaluating Transparencies

The final use should determine the method of evaluating color transparencies. Sorem and Nelson[17] recently studied the chromaticity requirements for viewing transparencies, and the *American Standards Association* is attempting to develop standard methods for viewing color transparencies and prints. My transparency viewer incorporates some of Sorem and Nelson's suggestions. It is a box with two G.E. 20 watt Photocolor fluorescent lamps. The lamps are 3½ inches apart and 1½ inches below the flashed diffuser. The external surfaces are painted flat black. Interior surfaces are painted with *Sherwin-Williams Kem-eg-shel White (E80 W 3)*.

Acknowledgement

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Radiograph and Specimen Montages*

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GOOD medical photographs must show the medical features of the subject clearly and accurately and, within these limitations, should be pleasing pictures of good photographic quality. Photographs of gross specimens and patients often fulfill these requirements. Good reproductions of radiographs usually show clearly the location of a particular condition. The purpose of this presentation is to demonstrate that when possible a combination of both photograph and radiograph reproductions on the screen at the same time will produce more effective illustrations that are better teaching aids in medical instruction.

The combining of radiographs with photographs or drawings is not an innovation. There are a few examples of this work in the literature [1,2,3,4]. Because the possibilities seem to be much greater than have been taken advantage of up to the present time, it seemed worthwhile to expand this idea by photographing a variety of subjects on both black-and-white and color film. By placing a radiograph of the subject on an illuminator and using it as a background, or by combining it in one way or another with the subject so that both can be seen at the same time, it is unnecessary for the observer to mentally retain an image of the previous slide. They are both on the screen at once!

Illumination

There are many types of illuminator that could be employed for a combination radiograph-specimen picture. Among these are: (1) a fluorescent illuminator of the type used in radiography departments for viewing X-rays, (2) a box with warm white deluxe fluorescent tubes such as is used in this department for transilluminated backgrounds or (3) the older type tungsten lamp X-ray illuminator. The fluorescent X-ray illuminator produces a bluish background (Fig. 1a). The warm white deluxe tubes picture the background much less bluish (Fig. 1b) since the red content is greater. In our opinion the illuminator that produces the most pleasing background is the older, tungsten lamp type, still found in most hospitals. We placed one into the legs of a stool which had been turned upside down. Blocks were set on the corners of the opal glass of the illuminator to hold a clear glass which became the support for the radiograph. Thus an air space between the opal glass and the clear glass was provided to permit the heat from the illuminator to escape so that the radiograph, when placed on the clear glass, did not get too hot. Then, by laying another sheet of clear glass on top of the radiograph a support for the specimen was obtained. To get sufficient

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Figure 1. Radiograph background color obtained with various light sources. See text for explanation.

Figure. 2. Tungsten X-ray illuminator in up side down stool.

light for the radiograph, so that the illumination approximated that of the specimen, the lamp in the illuminator was replaced by a 500W inside frosted lamp (Fig. 2). Because *Ektachrome Type B* film is used in this department, a lamp having a color temperature of 3200K was chosen. But this produced a hot spot in the center of the picture (Fig. 3). This problem was solved by substituting for the 3200K lamp, a 200W aluminum tipped lamp (Fig. 1c). Tests also were made with the 3200K lamp after coating the tip with aluminum bronze (Fig. 1d). A light blue glass was substituted for the upper clear glass and shots taken with the 200W lamp (Fig. 1e) and the 3200K (Fig. 1f). In our opinion, both seemed to be too blue. The 3200K lamp without the addition of a blue glass produced a slightly blue-tinged radiograph background color comparable to the slight bluishness in a *Blue Label* X-ray film. Many pictures were taken on this background (Fig. 4a) and on the warm white deluxe fluorescent light box (Fig. 4b) with pleasing effects. Of course, the blueness or grayness of the radiograph background color may be decided by one's own personal taste. Perhaps the best is to reproduce the background about as seen in the original radiograph because people are accustomed to seeing a slight bluish color under ordinary viewing conditions.

One day a very interesting, but not particularly photogenic kidney with calculi was brought to the department to be photographed. It seemed as though the subject might be better illustrated by combining it with a radiograph of the patient which showed the stones *in situ*. A series of pictures was made using different lamps, glass and a variety of positions of the kidney; some gave good results and some not as good. A few of

Figure 3. Hot spot produced by the inside frosted tungsten lamp.

the possible combinations are shown in Figures 5(a) and (b) and 6(a) and (b). Obviously, in a journal, pictures can be readily reproduced together, but for slide projection, this is not as easy. Better illustrative material may be shown on the screen by placing the radiograph itself in any of the above illustrated combinations.

(A)

(B)

Figure 4(a) Metastatic carcinoma to iliac (b) Arteriogram. Thrombus in left iliac artery.

Probably for the majority of pictures of patients and gross specimens, the ordinary photographic set-up is adequate, but in many cases, the only thing possible. Such photographs are found unfortunately. This also applies to radiographs of specimens removed at autopsy or operation are not employed as often. For example, a photograph and radiograph of a dermoid cyst is illustrated in Figure 5(a) and (b). Preserving both the specimen and its radiograph is especially valuable when small bone fragments are present. But reproductions of radiographs of photograph of metastases to the spine

Figure 5(a). Renal calculi on upper glass.

Figure 5(b). Renal calculi on blue paper.

demonstrates the pathology which is not seen in the radiograph (Fig. 8). As slides, a greater impact can be produced if these are shown on the screen at the same time.

As a result of these experiments, it seemed desirable to use only X-rays of specimens that fulfilled certain technical requirements for radiograph-specimen pictures. The best radiograph would be one with a minimum density, yet one that retained maximum contrast and detail. Obviously, this goal was impossible to attain. If the radiograph was of high contrast, the overall density of the darker areas, such as soft tissue, was so great that when used as a background for the subject, long burning-in was needed. This was true even if a very low level of illumination was given to the subject. The radiography department was consulted and the problem was solved by adjusting the exposure, when taking the original radiograph, so that the subject density in the radiograph was lowered, yet, the background density was retained. Normal development was used, thus keeping the usual contrast. Such radiographs were produced with a regular screen, X-ray film and a cardboard holder. Therefore, instead of having the soft tissue detail in the radiograph almost obliterated, requiring burning-in, it was light enough so that the exposure was the same as that required for the subject when using the customary photographic lighting. The following factors for the radiographic technic were found to give the desired result: a 40-inch focal-film distance, 100 MA for 1/4 second (25 MAS) 52-56 KV and 3 minutes development with continuous agitation.

X-rays of small subjects, which, of

course, were made on small X-ray film, were handled by cutting a black paper mask to fit around the subject so that a black background would be obtained continuous with the blackness of the radiograph itself (Fig. 9). This method gave fairly good results (Fig. 10). When the specimen was small enough to permit, it was decided to photograph the specimen on half of a large sheet of X-ray film leaving the other half for the background of the specimen itself so that a continuous black background would be obtained (Fig. 11). The results with this method are shown in Figure 4(a).

The same as with the gross specimen, it is even more important, when the subject cannot be immobilized, to have the radiograph as thin as possible, yet with good detail and fair contrast. The importance of this cannot be overemphasized when photographing the head, hips, chest, etc., of patients. Thus with the radiograph in the field of view, its exposure is not too much more than the exposure required for the subject. The only other alternative is to place less light on the subject requiring a very long exposure, in which case the patient would be likely to move. Photographing hands and feet with the radiograph as a background is somewhat easier, as exemplified in Figure 12(a) and (b).

These principles and methods can be carried still further if so desired. For example, a picture of a patient, radiograph of the patient, the specimen removed at operation, the radiograph of the specimen and a photomicrograph can all be included in one composite. This, of course, can be done in either black and-white or color. In the case of black and-white, small transparent positives can be mounted together. In the case of color, for example, four 35mm transparencies can be mounted together on one slide (Fig. 13).

Summary

The medical photographer cannot introduce imaginary aspects into a picture, but he can use his imagination in handling the subject matter.[4] The truth of the matter is that ingenuity combined with a free imagination often produces a picture which is aesthetically pleasing and yet embodying a high degree of instructive merit. It would be neither practicable nor desirable to try to photograph every subject in combination with a radiograph. However, when the proper opportunity presents itself, the photographer has an excellent technique at his command for adding something of value to his medical photographic teaching library. Certainly there are many possibilities for expanding such techniques further than have been covered in this short discussion.

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Figures 6 to 13 of this paper will be found on pages following (pages 92 to 96).

Figure 6(a). In original color transparency background was cut out to accept radiograph.

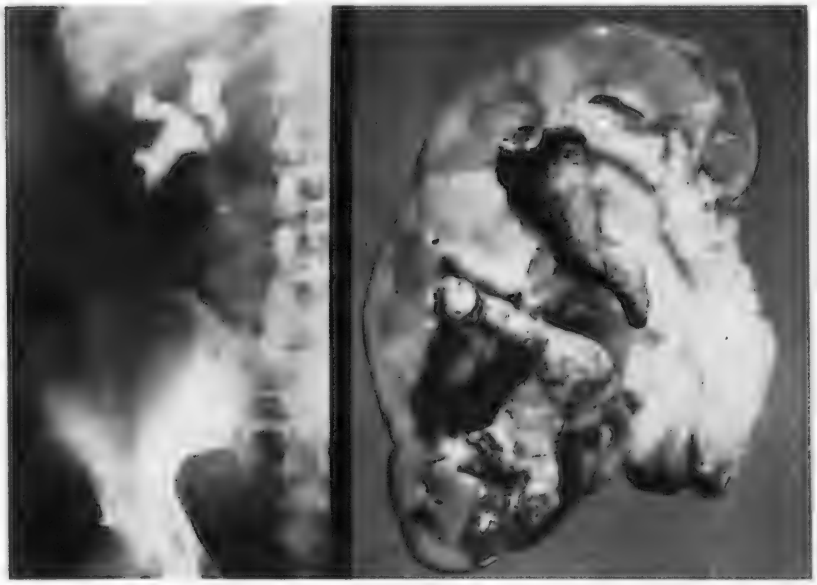

Figure 6(b). Radiograph and specimen shot separately, then combined on a single slide

Figure 7(a). Dermoid cyst showing hair and some of the teeth.

Figure 7(b). X-ray of dermoid cyst showing all the teeth.

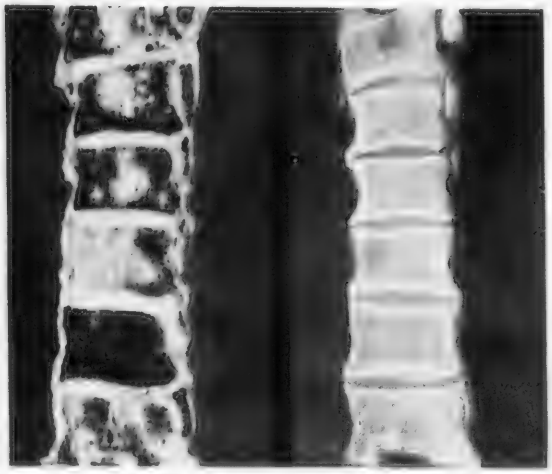

Figure 8. Metastatic sarcoma to spine. In color, mounted together on a single slide.

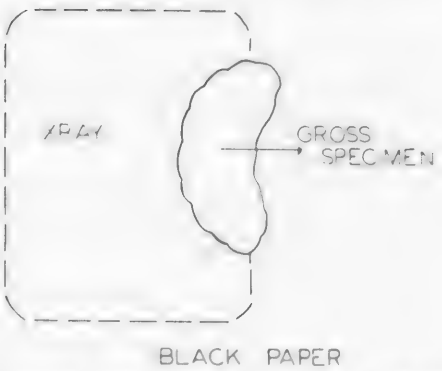

Figure 9. Black paper mask placed on illuminator for small X-rays.

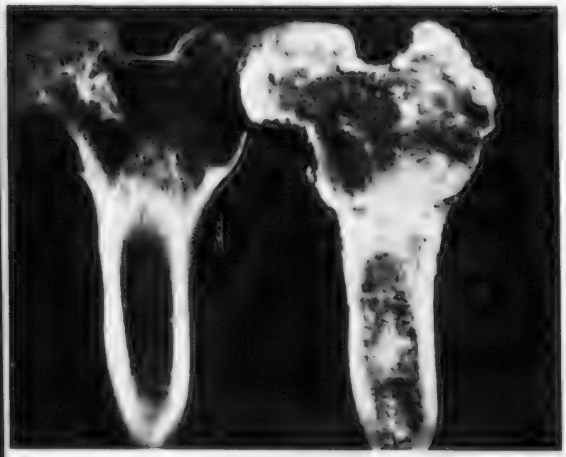

Figure 10. Femur cut section photographed on black paper mask.

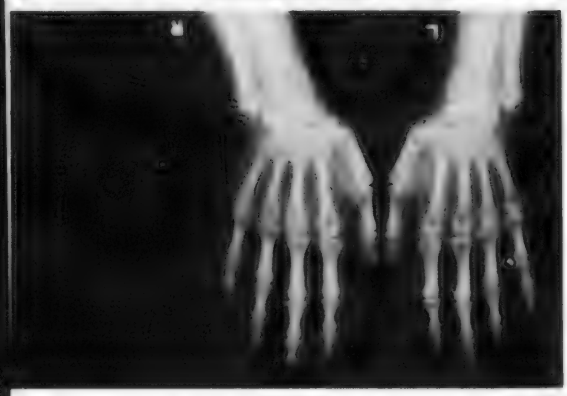

Figure 11. Reproduction of the radiograph with black area for subject background.

Figure 12(a). Subject on the left side (anatomically).

Figure 12(b). Subject on the right side (anatomically). This seems better because reading left to right the subject is seen first as one would expect.

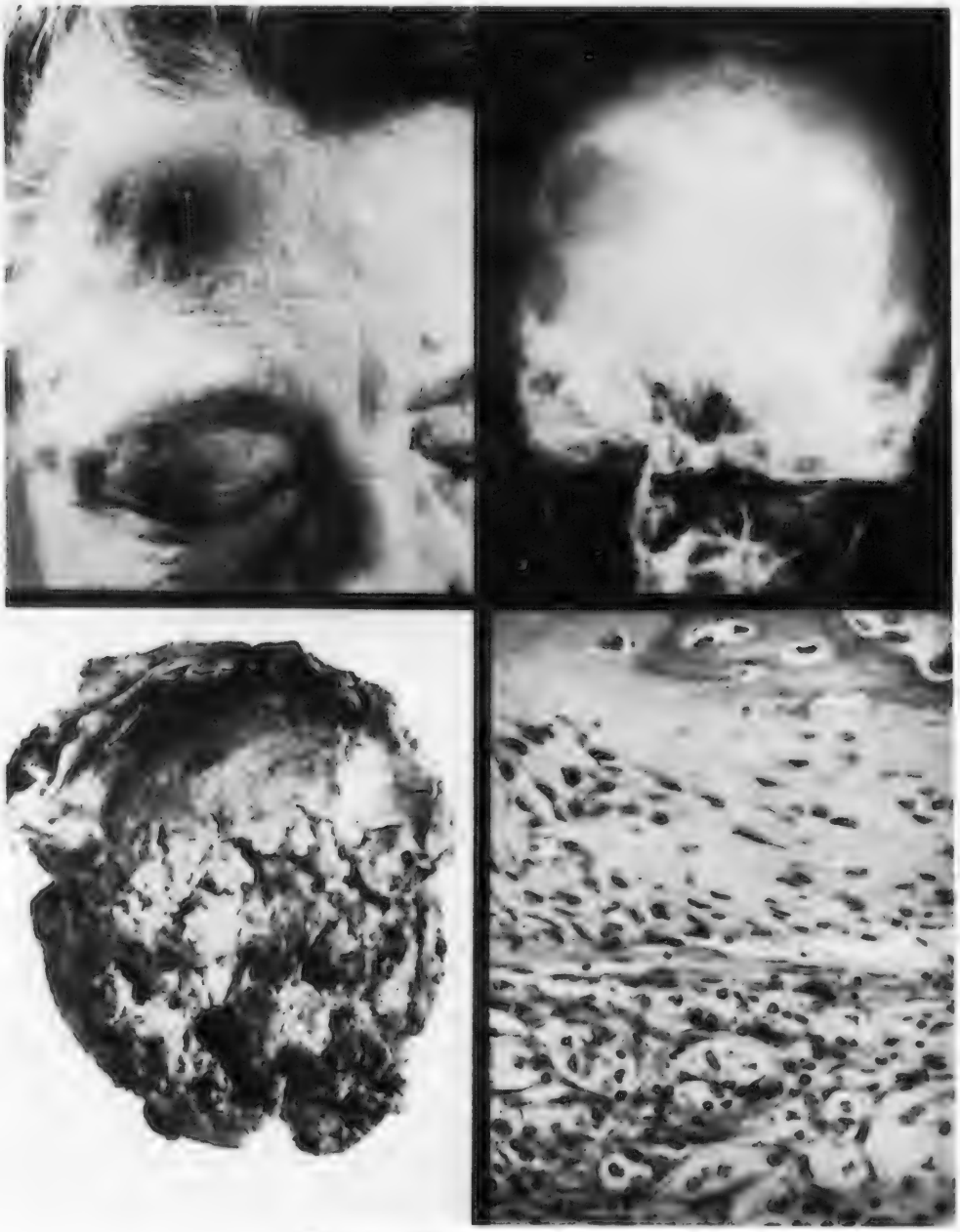

Figure 13. For projection as a unit.

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Making 35mm Transparencies By Projection*

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AS anyone who has tried making black-and-white transparencies by contact will agree, a major difficulty is dust. Spotting a print is easily done, but there are few who can successfully spot out dust marks on 35mm film (or 2 in. x 2 in. plates) which will pass muster when viewed on a screen under a magnification of 30 times or more.

In general, printing 35mm transparencies by projection removes an important source of trouble by eliminating the glass plate of the printer. Also, it lends itself to all of the advantages of enlarging over contact printing: using the best portion of the negative, improving the composition, and dodging. Projection is generally faster, and less handling of the film or plate is involved, thus reducing the chances of scratching or marring the positive or negative.

Where positive film is used for making transparencies a simple device, easily constructed and quite inexpensive, permits making the slides by projection right into the 35mm camera, if the camera is one from which the lens can be removed. The film is not handled at all, except during loading and processing. The results show considerable improvement over other techniques.

Only the *Leica* is considered here, but the method is adaptable to any other 35mm camera (*Contax*, *Exakta*, etc.) which has interchangeable lenses. The dimensions vary, of course, with the camera model. The device is shown in Figure (1), and with camera attached in Figures (2) and (3).

It consists of a plywood base, about 6½ in. x 9 in., on which is mounted by means of a hinge, a bracket to which the *Leica* body can be attached. Similarly affixed to the base with a hinge is a wood flap, roughly the size of the camera, so that flap or camera can lie flat on the base, roughly in the center. It may be necessary to countersink the base in those places where the eyepiece of the camera (or flash socket) project beyond the plane of the camera back to permit the camera to rest perfectly flat.

The flap has a small white area (dull plastic, paper or dull paint) about 45mm x 60mm in size, representing the easel on which the projected image is focused and composed. This area contains a rectangle, 24mm x 36mm, outlined in black ink, which are the picture limits for the transparency, i.e., the size of a *Leica* frame. The only important dimension is the thickness of the easel area of the flap, which is made 3.5mm. the distance from the back of the camera to the plane of the film. Even this is not critical because of the great depth of focus inherent in the method. An image which is in sharp focus on the easel will be in exact focu

*Received for publication May 15, 1955.

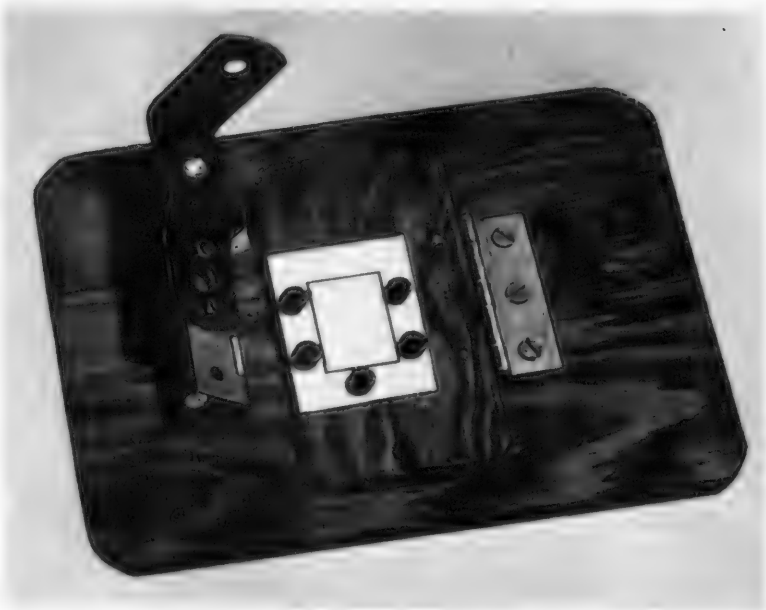

Figure 1. Device for making transparencies by projection directly into a 35mm camera.

Figure 2 Flap in position for composing and focusing image on the easel

on the film when the camera is laid down in place of the flap.

It is not at all difficult to determine accurately where the rectangle should be drawn. A white card is slipped into the camera in the film position and the cam-

Figure 3. Camera body replaces flap. Film is in same plane as previously occupied by easel

era mounted on the bracket. An enlarger lens is required which, with sufficient extension, will give a 1:1 image. With a *Focomat* enlarger, the 90mm lens with 75mm extension permits focusing down to a projected image which is also 24mm x 36mm. Without a negative, and using only the negative carrier to provide the required outline, the enlarger head is lowered and the focusing mount and lens barrel adjusted until the projected image on the easel area is 24mm x 36mm in size with sharp edges. The camera is then substituted for the flap, the shutter opened to "time" and the assembly moved about until the image accurately covers the exposed card. The flap then replaces the camera, and the illuminated rectangle will show just where the frame is to be drawn. Henceforth, frame and film will occupy the same area when interchanged.

For use, the recommended enlarger lens is the 90mm with 60mm of extension. This will afford the most useful range of magnification: from a little more than 1:1 to a little less than 1.5:1. More extension will give a smaller image; less, a larger image. The autofocus feature of the enlarger does not interfere in this use. The working distance between the camera and the lens is ample (Figure 4) and yet is short enough to obviate the risk of the lens flange of the camera cutting off the corners of the image.

To provide for making test frames, thumbtacks are placed around three sides of the outline so that they will hold a piece of film in the correct position. This will also serve for making permanent slides when only a few slides are to be made at one time, or when it is necessary to give each slide individual development treatment.

To use the device, a length of positive film is first loaded into a cartridge, the cartridge loaded into the camera, and the body fastened to the bracket. The image is focused and composed on the easel area with the lens wide open. The

final focusing is done easiest by raising or lowering the enlarger rather than with the lens. Lens aperture is then reduced to f/8 or smaller to give increased depth of focus to overcome slight focusing errors or curvature of the negative. A small aperture also affords a long enough exposure time for dodging and tends to cut down vignetting at the corners by the camera lens flange.

A piece of positive film is placed under the thumbtack heads and a test is made. It is most important that a constant time of development is maintained for all tests since the whole roll of film will be developed at one time for the same interval. The test frame will clear in about one minute in fresh hypo and can be inspected by looking at it through a safelight. After a satisfactory test, the camera replaces the flap, the shutter is opened to "time" and the enlarger light turned on for the correct interval. The shutter is then closed and the film advanced. This method leaves both hands free for dodging.

The finished roll can be processed on a reel in an open tank or run through a tray, hand-held. No attempt should be made to use a daylight-tank method, since pouring the developer into and out of the tank takes almost as long as the developing time of positive film, which is of the order of two minutes.

It is best to make two or three slides of each negative, varying the exposure slightly (at least by 50%) just for insurance, since bulk positive film is relatively inexpensive. The development should be one-third or one-half longer than recommended for the film and developer used, and the transparency should be a little denser than required for proper projection. The best technique is to reduce the slides one at a time

Figure 4. Device in position under enlarger lens. Controls of camera face operator.

(after complete processing) under artificial or daylight illumination, to facilitate judgment of proper density. Normally Farmer's reducer diluted with an equal amount of water will give a controllable rate of reduction. Unusual control is made possible by employing three different reducers: subtractive, proportional, and super-proportional which, while reducing, will respectively enhance, maintain or lower the contrast. The formulas can be found in many photographic handbooks.

Summary

A device is described permitting the making of 35mm transparencies by projection directly into the camera body, the lens having been removed. Besides all the advantages of enlarging over contact printing, the method eliminates a great deal of the dust common to printing by contact, and provides for a minimum of film handling.

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Photo-Colposcopy*

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Introduction

PHOTOGRAPHY of the vagina and cervix uteri is now an universally accepted method for the demonstration of pathologic changes in this region. Good photographs of lesions of the vulva vagina and cervix are necessary for permanent clinical records and in medical education.

Footer[8] routinely presents 35mm slides to students and staff in the obstetrical and gynecological wards. Kimble[13] in his article reproduced 16 photographs of cervices before and after treatment of chronic cervicitis. Bowen[1] for years has made serial photographs of the various lesions of the cervix uteri he encountered in his practice for permanent record.

Photographs in color are especially advantageous for teaching purposes because of their natural likeness to the original objects examined. Since 1935 when Creer first published his methods of photography of the cervix uteri, many different techniques have been described in the literature. Various types of apparatus as well as shapes of vaginal specula and different sources of illumination have been employed in photography of the cervix[2,6,9,15].

Since the advent of the modern colposcope for visualization of the cervix with a magnification of 10X to 40X greatly improved photographic attachments have been designed which make photography a simple matter. Multiple light sources, intricate lens systems and specially designed vaginal specula are not required. The clinical pelvic examination and the picture taking are done by the physician without the slightest discomfort or annoyance to the patient.

In this paper a method of clinical visualization of the cervix by colposcopy and photography of this organ by photo-colposcopy will be described. Reference will also be made to another method of photography of the cervix, namely the colpophotograph.

In photo-colposcopy, the photographs of the cervix are taken simultaneously with the visualization of the organ under magnification, whereas with the colpophotographic apparatus the picture taking is a separate procedure.

Method of Photo-colposcopy

It should be mentioned that the prime use of the colposcope is for the detection of minute lesions of the cervix as an aid in the early diagnosis of cancer. The colposcope used in this study is the Hinselmann designed instrument manufactured by D. F. Moller, Wedel-Holstein, Hamburg, West Germany, Karat Ltd.[11] and Metrik Ltd.[16] participated in the development of the photographic attachments to the apparatus (Fig. 1). The apparatus consists of a heavy upright

*Presented at the annual meeting, April 29, 1955

Figure 1. Moeller (Hinselmann) colposcope with Leica camera attached.

base with extension arms upon which the optical portion of the colposcope revolves. This part consists of a binocular system of lenses, a small lamp and mirror arrangement for source of illumination, the action of which is controlled by a foot switch. With this colposcope a magnification of the field can be changed from 10X to 40X by the movement of a small lever.

A channel in the optical portion of the instrument allows for the insertion of a periscopic lens to which a *Leica* camera frame is attached for photography. When the cervix is brought into focus with the colposcope, the organ is in exact focus for taking pictures. When the cable release is pressed the illumination is automatically intensified and the film is exposed. Although the cervix is magnified, the photograph obtained is life size. With the colpophotographic apparatus used by Wespi[7], as well as others[5,11,20], photographs of the magnified cervix (3.5X or higher) result. With the Hinselmann colposcope, no time is lost to shift from the instrument to photographic attachment as in the apparatus used by Wespi.

In this study, a *Leica III F* camera and *Ansco* 35mm tungsten color film was used. The time of exposure was usually 1/5th second. Where the cervix was stained with Lugol's iodine for diagnostic purposes, the time was lengthened to 1/2 second. This film was selected because considerable time was saved in the processing, cutting, and mounting of the transparencies. To expedite identification, the transparencies of the uncut strip of processed film were first marked with crayon before they were cut from the strip for mounting. It was then easy to determine the identity of the patients. The field on the transparencies measures 22mm in diameter, from which enlargements of larger size can be made. As illustrative of photographs taken with aid of the colposcope, a few prints (enlarged 2½ times) are shown in Figures 2 to 6.

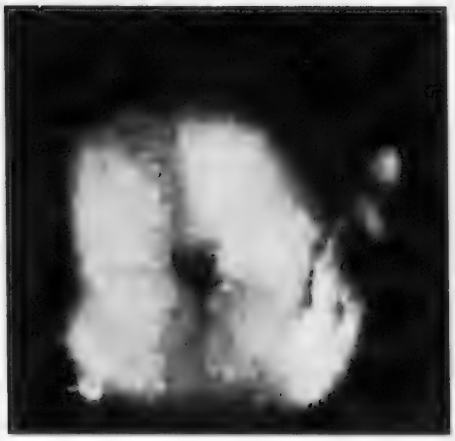

Figure 2. Small decidual polyp in 2 months pregnancy.

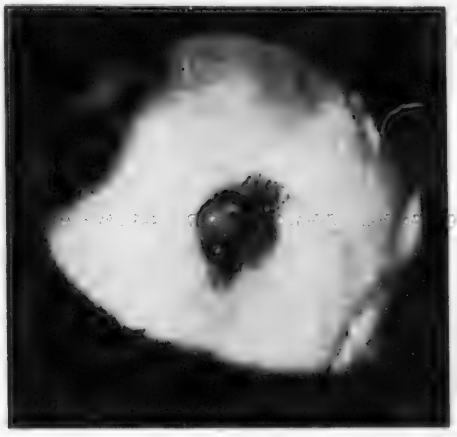

Figure 3. Cervix of patient in figure 2, after removal of polyp

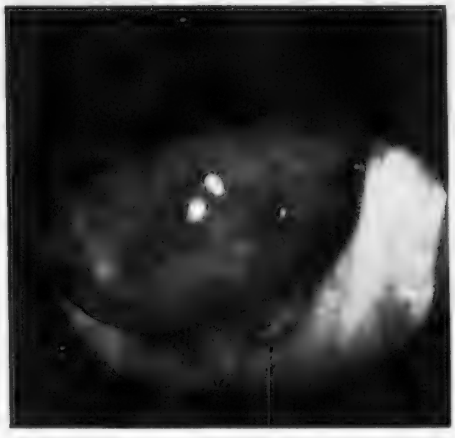

Figure 4. Cervix with protruding myoma.

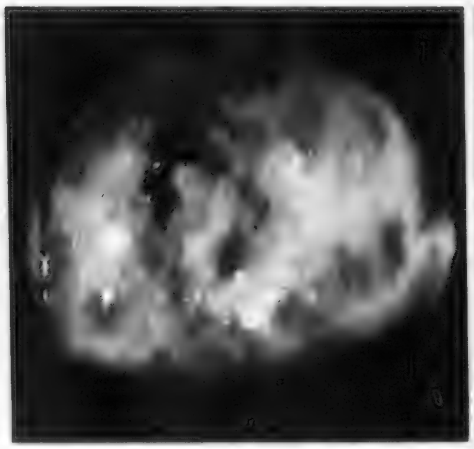

Figure 5. Cervix with punctate "strawberry" spots of trichomonas vaginitis.

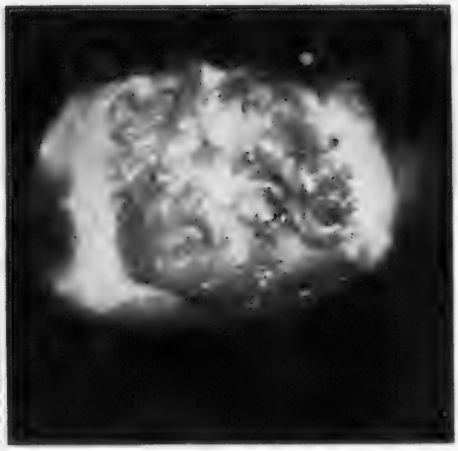

Figure 6. Cervix 2 months after abortion, showing eversion, and cyst immediately after electro-coagulation.

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Little Known Applications Of the Microscope in Science and Technology*

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IN Part I of my treatise on the development and the presence of microscopy, the equipment and optic research methods were outlined. In Part II it is attempted to stimulate scientists and technicians of all fields, by the description of little known micro-methods and their results, to 1) develop their own new methods, and 2) introduce methods tested in other branches into their own fields of work. The reader who is interested in a specific sphere can find more information in published manuals and periodicals.

For example, it is not generally known that the microscope is used in modern surgery. As yet, during a tumor operation, a specimen slide is made from a biopsy with a freezing microtome. Thereupon the section is quickly stained and histologically examined, to determine whether it concerns a benign or malignant tumor.

It is also unknown to the majority of microscopists (except bacteriologists) that one needs supplementary tools in bacteriology. The development of the transplantation needle has simplified the gathering of any number of isolated buds in order to make pure bacilli cultures, or to implant isolated buds in animal experiments. The essential constituent part of this instrument consists of a delicately constructed needle (with a point of about 1 micron diameter), which can be moved in any direction by the mechanical adjustments[12, 13, 14]. I therefore specifically show this arrangement and its significance because I am convinced that, besides taking the bacteria literally for a walk, that instruments can be useful for additional purposes in other branches of science — such as cell cultivation, microchemistry, and metallography.

Likewise, the fact may not be known to most medical men, unless they happen to be neurologists, that it is possible, as DE CRINIS[5] showed, to confirm with the help of optical coloration[4] whether a brain tumor is in question. This method, distinguished by simplicity and speed, rests upon the following: in order to examine the brain tissue that has been biopsied, it is placed on a slide, in small amounts. Then the brain fibres are pulled to threads with a needle in physiological common salt (NaCl) solution or 1-2% bichromate solution, covered with a coverglass, and examined under the microscope by means of this optical coloration, without pretreating or staining the tissue. Only with the optical coloration can the tumor tissue be distinguished from the brain tissue. The same optical coloration method can also be used successfully in the exhibition of cystical fluids. I have used this example of optical coloration especially because I am convinced that with its help results would also be successful in many other scientific fields of research. It would find application through the elegance of the method and the time-saving by evading the lengthy chemical coloration which, in addition, presents a strong interference. Modest beginnings are already in sight, for example in yeast analysis, studies of cell physiology, and urine analysis.

In botany, the microscope is not only useful in the normal anatomical and histological investigation, but also in palaeobotany. This gives us an insight into the histological construction of plant remains millions of years old, as described in a presentation by E. HOFMANN[11]. We also have to thank the microscope for the present high standards in the research of heredity and breeding. With its help it is possible to get an insight into chromosomes, the carriers of heredity characteristics[1]. S. STRUGGER[15, 16, 17] has found new and fine results in his studies, *Physiology of the Cell, the Protoplasm and the Cellwall*. In his cell physiology studies he introduced some elegant methods which were only made possible through the use of fluorescence microscopy. At the same time he could study the dependency of [illegible] to react differently in the alkaline and the acid state. That goes also for the acridine-orange stain which is used in the specific fluorochromization of the nucleus, protoplasm and cell fluids. Acridine-orange for example stains the cell [illegible] of raw common kitchen onion copper-red with a pH value of over 6.5, while they stay unaffected with a pH value of less

*From the Journal "Mikroskopie" Wien, Band II, 19[illegible]
**Late Editor of the Journal "Mikroskopie"

than 6.5. On the other hand, the cell walls are stained a glittery copper-red with a pH value of 2.9 - 6.5, while with a more acid reaction, with a pH value of from 2.8 downwards, no trace of red color is present, and only a faint blue-green "imbitions-coloration" is visible. In this special case a good explanation is also possible. The discharge point of the cell membrane has a pH value of less than 3.0. Thereupon lies the negatively charged cell wall which an electro-absorbatively fix the positively charged cation. The top limit, at the pH value of 6.5 is explained according to HOEFLER[2], by the competitive stacking of the cell fluids, which only begin to stack the dye in the form of polymeric cations above the pH value of 6.5. The numberless disclosures on the problem of permeability which we owe to fluorescence, were described in great detail by HOEFLER in this periodical. I singled out this illustration of secondary fluorescence which has shown such exceptional valuable cognition to stimulate all other biological branches of science, and to promote the introduction of secondary fluorescence in inorganic material which, if we see to the end of the Morin reaction with aluminum, has found no application whatever.

In order to name also two interesting applicable examples in zoology, I refer to research about the learning aptitude of lower animals, which is possible only with the help of the microscope[3, 4, 5]. It proves that even unicellular [illegible] a willingness to learn, a capability which was only credited to higher animals. The experiments, for example, concern the reaction of these organisms (Ciliary and turbellaria) to light and darkness, shock, cold, heat and electricity, etc.

Not less interesting are the experimentations on living organisms on which Storch[21] worked. They rest upon the simultaneous use of the microscope and a high frequency motion picture machine which permits an exposure of up to 240 frames per second. Upon projecting it at about 16 frames per second, a 15 times slow motion reduction is made possible. Through the simultaneous exposure [illegible] picture, it is possible to follow through an exact diagnosis. Only time-lapse photomicrographs of small living organisms help to gain the inside view into the life and frequently interesting movements of the organisms.

Strange to say, in chemistry even today, the microscope is used comparatively little. Although a microchemistry does exist, it is not the one microscopic chemistry but a variant of the practiced qualitative and quantitative chemistry with its means adapted to small amounts of substance. A very essential step towards developing a real microscopic chemistry was made by L. and A. Kofler[19] in their micro-meltingpoint proceedings. The basis of this method is the long-known fact that a mixture of two non-identical chemical substances shows a lower melting point than either of them in their pure state. In the implest case a sample of the substance to be proven, and a small amount of the other substance, are taken and placed on a slide, and melted so that the two substances form a narrow area of fusion. If the known substance and the substance to be proven are identical, the microscopic examination on a heatable stage shows that the whole preparation will melt at a definite temperature. However, if the known and the test substance are different, the border zone of the material fusion will melt first, while the two pure substances on either side follow at a higher temperature. Under some circumstances, however, these investigations show that the two substances have themselves undergone changes to form a new compound. In this case two new zones of lower melting point will form on either side of the new compound. This method can of course be also used in innumerable other chemical investigations. Compounds can be developed from materials of which only traces are available. Entire melting point curves can be determined; supercooling and superheating proceedings can be followed up; differences between points of solidification and melting can be confirmed, etc. The procedure has been so much enlarged by its authors that today its usefulness goes already far beyond its original idea, the determination of the melting point, with the least amount of substances. At the same time, the observation in which the use of the polarized light is not the least contributor, is certain and accurate. At the present time the procedure is only applicable with organic substances; the development of microscope stages that may be heated to a higher degree will probably enable further expansion with inorganic problems. A detailed and extensive presentation of the proceedings in its newest developments has already been written by A. Kofler[17] in the 5/6 number of this periodical. The practical application of these elegant methods has greatly progressed, but by no means become as general as it deserves.

I mention one method, probably familiar only to the mineralogists, because—modified correspondingly—it might be applied to other fields. The procedure which Koeler[16] described in detail in the 5/6 issue of this magazine (*Mikroskopie*), rests upon the fact that with the help of the universal rotating stage, in conformity with the Fedorow methods of orthoscopic and conoscopic examination, optic mineral constants can be determined, which in their turn can make possible the final determination of the chemical composition. Conceivably, the individual small crystals of a mineralogical specimen slide are hardly open to a chemical analysis. On the other hand, there are innumerable chemical variants especially of felspar. Calcium nitrate felspars "plagioclase" are anyway an isomorphic group of mixtures whose actual composition can be definitely fixed from optical measurements. Here the previously mentioned procedure will help. Each felspar variant has its own specific optical constant, which can be fixed for every individual crystal with the help of the Federow stage. Thus it is possible to obtain the exact physiology of the mineral, and an important step is made towards determining the formation and geological sphere.

A technically interesting method, known only in the closest professional circles which could in all probability "mutatis mutandis" also be applicable in other problems was worked out by Michel[17] to examine pearls. The apparatus was developed by C. Reichert, Wien (Vienna). It is known that the pearl-oyster can be artificially stimulated for the cultivation of pearls, when it is induced by the introduction of foreign bodies to secrete the pearl substance. Besides the real genuine pearl and the false pearl, there exists a third type, called the true artificial pearl. Its value is considerably lower than that of the real, genuine pearl. A safe diagnosis however is only possible if one can successfully find the artificially inserted stimulant in the middle of the true artificial pearl, or confirm its absence beyond any doubt in the real genuine pearl. From the outside exact differentiation is impossible. As the notching of a pearl is naturally out of question, the examination is possible only through the narrow bored hole. As a matter of fact, it was possible to manufacture mirrors small enough to be inserted into the pearl. With their help, it is possible to examine the pearl's build-up layer by layer to its center, and to establish without doubt the possible presence or absence of an artificially inserted foreign body. Although the mirrors, set at less than 45° to the optical axis of the apparatus, are less than 1mm in diameter, and although both the lighting and the entire investigation are taking place through that tiny hole—which must be just big enough for the pearl string—it is possible with respective microscope contrivances to search systematically the wall of the hole and thus the inner construction of the pearl. Even good and clear-cut photomicrographs could be taken, which furnish special proof in cases of arguments. I described this method of investigation, developed two decades ago for the specific purpose of the examination of pearls, and I could conceive that it might have innumerable applications in industry and technic. For instance, one would want to examine the sidewalls of narrow borings with regard to the condition of treatment and the quality of materials etc. It is certainly not generally known that the walls of a narrow cylinder can be examined microscopically in this way.

A decisive factor in the applicability of metallic materials is their hardness. Although hardness can hardly be comprehended physically exactly, it is an empiric-technological important index. Now most of the modern metals in use consist in no way of nothing but allotriomorphic crystals, but nearly always represent conglomerates of different kinds of metallic individual. This necessarily results in the conclusion that the traditional kinds of determination of hardness can only furnish average values, because the indentor of the customary examiner of hardness affects as a result of their relative size simultaneously thousands of individual allotriomorphic crystals which presumably have essentially different "individual hardnesses" within themselves; the macro-determination of hardness furnishes only a "integral value". Therefore it suggests itself to look for ways to determine the hardness of the definitely microscopically visible crystal individuals. Simple as the problem may seem, its technical solution is difficult. A way had to be found to first choose under high magnification on the metal grinding, an individual crystal to be tested; and then with a likewise microscopic indentor, to carry out the test directly in the center of the microscopic field in view, under exactly measurable pressure. Several firms took the risk to remove the technical problems existing at that [illegible]. The

Mikrohaertepruefer" (micro hardness tester), built by C. Reichert in Vienna, has a powerful dry objective and diamond, ground in the form of a pyramid, which serves as an indentor. Both of these rest on a common sliding carriage, shiftable for accurate distances. First the carriage is set in such a way that the objective with which the test allotriomorphic crystal is selected, is inserted. Then, by switching, the objective is exchanged for the pressure diamond which is now pressed into the substance to be tested, under exactly gauged pressure of a spring. At the same time, a scale is visible through the microscope which shows the pressure employed. Finally the objective is switched over again and the magnitude of the pressure track is measured to less than 0.001mm. The pressure employed and the diagonal length of the quadratic pressure track, set into a simple formula, furnish the hardness of the individual crystal. Groups of experiments with the micro-hardness-tester already brought about interesting results. 1) It showed that -as expected- the metals are frequently built up of constituent parts of quite different hardness; 2) it proved -and this was less predictable- that in the microscopic domain, the pressure employed and the magnitude of the pressure track are not proportional to each other. Small pressure tracks require, comparatively speaking, a higher pressure influence for their production than large pressure tracks. The micro-hardness obtained with this method must naturally be well distinguished from the macro-hardness so far customary, in which the size of the pressure track and the applied pressure are strictly proportional. Micro-hardness-testing is as yet technically and methodically in its infancy of development, but it can already be said that it will be of great importance in metallurgy. In view of the importance of the procedure we will bring in one of the next issues of this magazine (Mikroskopie) a study by Prof. Mitsche[9] (Institut fuer Metallkunde an der Montanistischen Hochschule, Leoben) in which full and particular accounts of methods and results are given.

Fluorescent microscopy is still too unfamiliar in its versatile applicability. The fluorescent microscopic proof of Porphyrin, found at a time when the modern efficient fluorescent microscopes were not yet in existence, can already today be designated as "classical". Porphyrin, an organic pigment, infiltrates numerous organs of the body in certain diseases (Porphyria congenita), comparatively rare -to be true. Borst and Koenigsdoerfer[10] succeeded in demonstrating these infiltrations in sections of nearly all tissues. That could only be done by way of fluorescent microscopy. For while chemical proof is impossible because of the small amounts, the substance reveals itself even in trifling traces by its strong, deep-red fluorescence. At the same time, the fluorescent microscopic proof accomplishes something which no chemical procedure could. Thanks to the intensive red glow of Porphyrin, one can not only determine its existence in the organ, but its presence or absence is revealed in every single cell. Thus not only the anatomical but also the histological distribution can be recognized. In addition to the comparatively rare general chronic Porphyria diseases, local Porphyrin infiltrations appear also with acute local occurrences. Loos showed[11] that in numerous diseases of the teeth (Pulpitis et al.), Porphyrin infiltrates the tiny dental canals. In a fluorescent microscope, a cut through such a tooth shows with dazzling red fluorescence within the glowing blue dentine zone, areas which suffered the pathological infiltration of Porphyrin. The fluorescent phenomenon is so distinct that the characteristic Porphyrin bands can be identified with a micro-spectrograph, so that any confusion with other red fluorescent substances can be excluded. Koller[12] reports extensively on Porphyrin in animals, in an interesting treatise, soon to be published. This example is to show that through an evaluation of fluorescent reactions in the microscopic picture, whether of primary or secondary nature, also the possibility of a quantitative analysis of the fluorescence is given, with the help of combined microscopic and spectral research method.

The most unusual and strangest problems which appear in microscopy probably occur in criminology. Every legal case -whether it concerns a gruesome murder or a simple fraud- represents a so-called singular phenomenon and every case requires its own methods of investigation. In criminology our interest is not especially centered on special peculiar instruments used, but rather on the adaptation of microscopic investigation to fields and problems which in daily life are not considered as belonging to the domain of the microscope. However, just by this the examples of criminalistic microscopy can have a stimulating effect to close in on otherwise apparently unsolvable problems with the mi-

plements of modern optics. The question whether a suspect was present in a certain area or at a certain place could repeatedly be unmistakably clarified by the comparison of dust and dirt which had stuck to clothing or shoes, with samples of the locality in question. If f.i. bits of pine needles are found in the shoe sole seams of the suspect, and the crime was committed in a pine wood, it would be hard for him to deny it. The question whether or not a shot was fired from a certain weapon, can be solved comparatively easily with a microscope. In every weapon the impression of the stroke of the pin shows its specific individual characteristic markings on the bottom of each cartridge, and the rifling also leaves its characteristic markings. Frequently it is enough to make a sample shot from the weapon in question, to compare a shot or cartridge found in the area of the misdeed, in order to make statements on the materials from the information found.

For all concerned much may depend on whether a material was torn or cut, and in the latter case whether with a knife or scissors, a sharp or a dull tool'. The question can of course only be answered microscopically. However, a few simple test trials on the materials in question will give the experienced criminologist indications which will enable him to make a decision of nearly 100% certainty. In any case, criminology shows impressively that the microscope is frequently the only and at the same time perfectly sure means for a decision even if used in apparently quite "unmicroscopical" cases a fact of which many fields not only sciences but also the arts should make use.

The microscope will find many more uses and should not remain restricted to traditional fields. For this reason, more or less proven but little known microscopic methods were described in this paper in arbitrarily chosen examples, in order to suggest opening new land in the microscopic field.

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Medical Photography as a Boon to Trial Lawyers*

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IT has been said rightfully that: "A picture is worth a thousand words" It has also been said that

"Indeed photographs admitted in evidence, subject to properly guarded inquiry as to the time when, and the manner in which, they were taken frequently convey information to the jury and the Court with an accuracy not permissible in spoken words."[1] (Italics mine)

The Iowa Supreme Court in State of Iowa v. Edward Ebelsheiser, 43 N.W. 2nd 706, 19 A.L.R. 2nd 865, pages 872 and 873, said

"Exhibit P-9 was a picture of Dorothy Robertson as she appeared when the photographer came. It shows her face swollen and one eye blackened. She testified the condition of her face was due to a blow by defendant, administered immediately after the shooting while she was trying to help her wounded husband. The picture was admissible as illustrative and possibly somewhat corroborative of Dorothy's testimony.

Defendant's counsel was obliged to excite passion and prejudice. *That might be true to the extent the photograph is more effective than oral description.* The articulate, or eloquent witness has that same advantage over one less vocally endowed, but his testimony is not thereby rendered inadmissible." (Italics mine)

18 Mountain Law Review, (April, 1946)

"Courts encourage the use of photographs for the jury is entitled to know the true condition of the wounds and objects [illegible] graphs than by oral testimony of doctors or others, the photographs are competent evidence. [illegible] when relevant and material, for if they show facts the jury should know, the fact that such conditions may awaken sympathy in the minds of the jury does not render the pictures incompetent." (Italics mine)

We thus have authoritative recognition that pictures are not only more accurate than the spoken word, but are more effective to convey a description of injuries to the Court or jury than the most articulate or eloquent witness.

This observation is especially true of the art of the present-day medical photographer. Pictures taken routinely at hospitals maintaining medical photography departments are graphic, dramatic and serve as the best media of demonstrative evidence.

It is unfortunate that trial lawyers generally have not awakened to the great potential of medical photography. Many trial lawyers in the United States who pride themselves on keeping current on new techniques of trial procedure, are totally unaware of the existence of medical photography departments in our large hospitals or of the skill, techniques or art of the medical photographer.

It astounds many trial lawyers when they learn for the first time, that there are [illegible] distinct photographic techniques, viz: General Medical Photography including 16mm motion picture records in color and black-and-white; Endoscopic Photography; Photography of Eye Movements; Retinal Photography; Fluorescence Photography; Photofluorography; General Photomicrography; Ultraphotomicrography; Photomicrography with Polarized Light; Fluorescence Photomicrography; Ultraviolet Photomicrography; Electron Photomicrography; Phase Photography; [illegible] Capillary Photomicrography; Photography of Living Tissues at Low Power; Slit-Lamp Photography; Cinephotomicrography; Ultracentrifuge Photomicrography; Special Printing Methods; Infrared Photography, Patient; Infrared Photography, Eye; Infrared Transil

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luminography; Infrared Photography, Gross Specimens; Infrared Photomicrography; Microradiography; Autoradiography; Slow-Motion Cinematography; Time-Lapse Cinematography; High-Speed Photography; High-Speed Radiography; Serial Photography; Recording Numerous Happenings; Recording Traces; X-ray Kymography; Cloud-Chamber Photography; Diffraction Patterns; Spectrum Analysis; Photoelastic Analysis; Schlieren Photography; Contouring Minute Structures Physical Records; Pupillography.[3]

In addition there has been much progress made in x-ray motion picture techniques and in direct cineradiography on full scale screen films and cinefluorography.[4] Much progress has also been made in an animation method for surgical motion pictures.[5]

Trial lawyers generally ought to be alerted to the magnificent potentials of medical photography and the various techniques now being used in that field. The use of color still photographs or even color motion pictures in important personal injury cases, either in the "brochure method" of preparing, settling, trying and appealing a case[6] or in the court room before Court or jury is urged.

It is recommended that when a trial lawyer knows in advance that a client, while a patient in a hospital having a medical photography department, is scheduled for a laminectomy [illegible] open reduction in the orthopedic field or plastic surgery operative procedure, that arrangements should be made, through the attending surgeon, to requisition full medical photography in the case. It is also recommended that the trial attorney consult with [illegible] to the best way to preserve the evidence of the various dramatic procedures. Personal interviews [illegible]

It is recommended to the trial lawyer [illegible]

(1) that the large hospital [illegible] medical photographic department,

(2) that present-day equipment and techniques of the medical photographer [illegible] dramatic motion picture color sequences,

(3) that [illegible] medical photographer would in general make an excellent court room witness. In some instances that he is a doctor or pathologist, but is always a skilled technician who can be of inestimable value to the trial lawyer,

(4) that many of the doctors are totally unaware of the value of medical photography in trauma cases and that most of the said doctors neglect to mention the possibilities or even existence of medical photography to the attorneys handling trauma cases,

(5) that there is a wealth of material available to the trial lawyer upon request to manufacturers of photographic equipment and materials.

Occasionally, defendant's trial counsel has used motion picture films to minimize some of the claimed residual effects of injuries in trauma cases. The effect of such films in jury cases has generally been electrifying! Plaintiff's trial lawyers have generally neglected to use the dramatic procedure of exhibiting motion picture film or stills or other photographic techniques of the medical photographer in the presentment and trial of personal injury cases. It seems to the author that the use of such material is far more dramatic, graphic and attention-arresting than the use already made of the techniques by defendant's counsel.

Charles C. Scott of Kansas City, Missouri author of "Photographic Evidence" (Vernon Law Book Company) in an excellent article in the Rocky Mountain Law Review, Vol. 18, No. [illegible] (May, 1946) entitled "Medico-legal Photography", pages 173-239, said at page 176-177:

"Many lawyers spend valuable time raking [illegible] the coals of antiquated cases that could be [illegible] better advantage [illegible] the preparation of more pertinently arranging for the use of photographs to demonstrate particular [illegible] photographic illustrations. Usually, it would seem that an attorney could [illegible] professional laxity when he fails to [illegible] photographic material which [illegible] to the issues [illegible]

[illegible] the [illegible] the [illegible] Many [illegible] [illegible] of photographic evidence. While [illegible] [illegible] the admission of photographs [illegible] this is becoming increasingly rare. [illegible] lawyers are beginning to realize that photography is not

merely one of these subjects every lawyer should understand, but probably does not. Today the enlightened practitioner knows that photography is an essential medium for the presentation of evidence worthy of the careful study of every member of the profession."

At page 239, Scott's concluding remarks are worthy of repetition here. He says:

> Finally, it is to be hoped that in the day to come lawyers and doctors alike will be trained even in law and medical schools to understand the application of photography to their professions. At the present time the usefulness of photography in medico-legal cases is only limited by lack of knowledge and when this disability is removed there is no doubt that few medico-legal cases will go to trial without being illustrated by properly prepared photographs."

Scott's article cites a great number of authorities on the admissibility in evidence of this type of photographic exhibits in both civil and criminal cases and discusses some of the various techniques and apparatus.

The author personally feels that the use of medical photography opens a new vista in the proper presentation of "demonstrative evidence". It is in full keeping with the beautifully expressive words of Dean Roscoe Pound, now Editor-in-Chief of the NACCA Law Journal and formerly Dean Emeritus of Harvard Law School. At page XIX of the Introduction to Volume 1 of Melvin M. Belli's new book "Modern Trials", Pound states:

> "What is set forth most thoroughly and deserves careful study by all lawyers, not merely trial lawyers and practitioners in personal injury cases, is the technique of demonstrative evidence and demonstrative methods of presentation to make clear and intelligible the facts and inferences in case of complicated or confused circumstances and occurrences, complicated machinery or apparatus, and items of loss or damage proper to be considered. *Specifically, the author (Melvin M. Belli) would make presentation of the just cases of the injured as complete and thorough as possible.* He would make the work of the lawyer who undertakes and advocates the cases of the injured as effective for justice as the work of the lawyer who by wise good counsel safeguards the interests of industry and business. Society today needs each type of lawyer. If the latter makes for maintaining the economic order and maintaining the social interest in the security of acquisitions, security of transactions and security of economic institutions, the former makes for maintaining the social interest in the individual life." (Italics mine)

It is by the use of medical photographers' art that the objectives mentioned by Dean Pound can be best achieved in making trauma cases "as complete and thorough as possible".

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Panel on Photomicrography of Medical Specimens*

JOHN J. BEITER, JOHN V. BUTTERFIELD, JULIUS WEBER, and OSCAR W. RICHARDS (Moderator)**

MANY requests were received to publish this session. As no stenographic record was made, the members of the panel have reconstructed the session as best they could from memory. The panel members first gave brief general discussions, followed by questions and answers. The questions are given in the form they were received from the audience, but the answers here may not be the same as the verbal ones at the meeting.

Mr. Butterfield, "Notes on Alignment": I believe the basic principles of the Koehler method of illumination are generally understood and that in setting up the illuminator, microscope and camera, these principles are followed. There are, however, certain adjustments about the microscope and illuminator that frequently are not made as carefully as they might be. These adjustments, or lack of them, may not be responsible for failure to obtain a successful photomicrograph, but they do give rise to some effects which the operator may recognize as undesirable and yet may be at a loss to explain their source, therefore, is unable to correct the fault.

The first adjustment I would refer to is the matter of the centration of the light source proper to the condenser lenses of the illuminator.

Figure (1) shows a diagram for the ideal condition of the Koehler illuminating system. If the light source is accurately centered to the illuminator condenser lens, which is generally in a tubular mount with the field iris mounted at the outer end, and other conditions of Koehler illumination are met, we can form an image of either the illuminator condenser aperture or the iris diaphragm at the illuminator in the microscope field of view. Furthermore, these images will be perfectly concentric, with the iris diaphragm cutting in symmetrically from the condenser aperture as the iris is closed.

MICROSCOPE ILLUMINATION ALIGNMENT

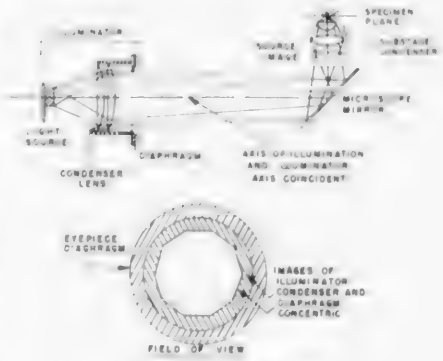

Figure 1. (See text)

After setting up an illuminator and microscope it is often found that the iris does not appear concentric with the illuminator condenser image. This eccentric condition and its cause are shown in Figure (2).

In the event the light source is not accurately centered to the illuminator condenser, we unwittingly tip the illuminator or rotate it sidewise to compensate for the lack of centration. The result is that the illuminator axis and axis of illumination are not coincident. Hence, the iris diaphragm at the illuminator is thrown to one side of the illumination axis. And since it is farther away from the source than the condenser lens, its image in the field of view may appear decidedly eccentric, although the image of the condenser aperture may be centered. It can be seen that tipping the microscope mirror, or centering the substage condenser in an effort to correct such a condition will only result in further maladjustment.

Reference to the substage condenser calls to mind another observation that can be made to judge the accuracy of centration between the microscope objective and substage condenser.

In Figure (3) we have again the image of the iris diaphragm at the illuminator as we might see it formed in the field of the eye-

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**Rochester General Hospital, Rochester, N.Y., Bausch & Lomb Optical Co., Rochester, N.Y., Riverdale 71, N.Y., American Optical Co., Southbridge, Mass., respectively.

MICROSCOPE ILLUMINATION ALIGNMENT

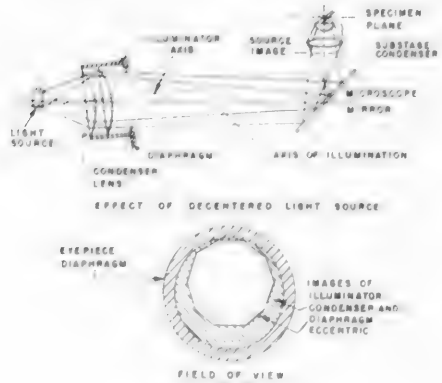

Figure 2. (See text).

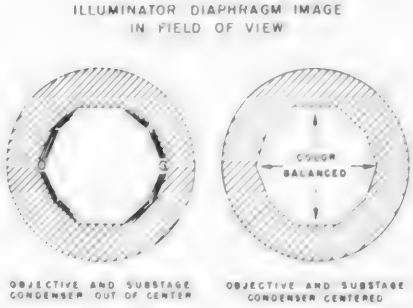
ILLUMINATOR DIAPHRAGM IMAGE IN FIELD OF VIEW
COLOR BALANCED
OBJECTIVE AND SUBSTAGE CONDENSER OUT OF CENTER
OBJECTIVE AND SUBSTAGE CONDENSER CENTERED

Figure 3. (See text).

[illegible] On the left is indicated what we see because of a decentered substage. If the diaphragm image looks an unsymmetrical color fringe similar to that indicated, then one should look to the centration of the substage condenser with respect to the objective. In the event the objectives of the microscope are on centerable mounts, one must of course be sure first that they are centered to the body tube. On the right, the conditions of an accurately centered substage condenser are indicated. The colors, and degree of color, will depend upon the type and correction of the substage condenser. The orange-green imbalance shown on the left is found with an achromatic condenser. With a good achromatic condenser, well centered, the diaphragm image should be practically color free.

A substage condenser centered but tipped in its mount will show flare around a portion of the image but not the unsymmetrical color of decentration.

Mr. Beiter: One important phase of photomicrography that I believe has received too little attention is that of the proper preparation and a knowledge of the material to be used for photomicrography. The photomicrographer is called upon to photograph many kinds of specimen slides through the microscope, such as tissue sections, stained or unstained; bacteriological smears; bone marrow and blood smears; and assorted mixtures of other preparations. However, since most of this work is usually done on tissue slides, a general but fairly complete knowledge of the technique of embedding, cutting and staining tissues, along with some knowledge of histology and microscopic pathology, is of value. In addition, some information about other subject material is also worthwhile.

The photomicrographer should be able to recognize different kinds of stains, bad stains, and thick sections, and should know what is considered a good section of a bad tissue and a bad section of a good tissue. He should realize what is important to have sharp and what doesn't matter, and also know when high resolving power is needed and when it is not, and when to use depth of field and when not to, etc. How do we know these things if we do not understand something about the subject? How do we know what histological subjects are the most important ones to emphasize or not to emphasize? In black and white photomicrography how do we know what structures are to be made dark, or conversely, medium light and so on. Of course, we can say, the *doctor* knows; he can tell us. We aren't supposed to know. Yes, there is some truth in this, but how much better it is if we know these answers. In case the doctor doesn't always know, we can still do a good job on the photomicrograph.

The contention that good photographers can take a good picture of anything is true up to a point. The photographer has some knowledge of most everything in life, both inanimate and animate objects, both indoors and outdoors. Therefore, when taking photomicrographs of medical subjects, how can we expect him to do an intelligent job and come up with a picture, except perchance, if he

does not have some knowledge of histology, microscopic pathology and tissue preparation.

Many people in the field of medical photography, contend that the medical photographer should tell the doctor what to do and how it should be done. This is only true, in my opinion, of things that are photographic, but how can we intelligently criticize the photographic aspect of it if we don't have some knowledge of the medical needs. Certainly, the medical profession and the public through the medical profession, need us the medical photographers but they can live without us. Can we live without them?

Dr. Richards: Mr. Butterfield has brought out a very important factor for successful photomicrography—the adjustment of the microscope condenser. When this is improperly done, as his slides showed, the spectral uniformity of the illumination is changed at the film. Many poor color pictures have been blamed on the film that were actually the fault of the photographer misusing the condenser. This is especially true with the two-lens *Abbe* condenser.

Mr. Beiter has stressed well the fact that a good picture cannot be made from poor specimens or drawings. Some of our medical members, notably Dr. Lattimer, have also made this amply clear. Dr. Lattimer's paper in the February, 1951 issue of our Journal should be made required reading for the patrons of the medical photographer. To refuse to work with poor material will require tact, but is essential to high standards for biological and medical photography. Better trained photographers can handle such problems diplomatically and this should be considered by our committees on standards and training.

Mr. Weber's desires for standardization of microscopes will certainly be given consideration by the ASTM Committee newly formed for this task. There are two active demands on manufactures today that are incompatable: one group wants a minimum of adjustments, preferably only one push button, and others demand more and finer adjustments for the microscope and camera. As to fitting older instruments with future improvements, there is always a practical limit to modernization. One shouldn't expect to be able to convert a wheelbarrow into an efficient and comfortable superautomobile or flying machine. However, competition is forcing interchangability which is in accord with Mr. Weber's suggestions.

Question and Answer Period

The following questions were submitted in writing from the audience and answered by members of the panel. (Q — Question)

Q: In the May, 1953 issue of JBPA, there appeared two articles concerned with techniques for better reproduction of Eosin (Y) stained slides when using *Ektachrome "B"* film. I have tried the techniques with good result. Has anything been thought of for good results with *Kodachrome "A"?*

Beiter: I assume the articles referred to were the, "Three Related Papers on Color Film Processing", JBPA, Vol. 21, No. 2. If so, although the photographer can adjust the processing of *Ektachrome "B"* he does not have any control in the processing of *Kodachrome "A"* since this is not done by the photographer himself.

Q: Where and How can one brush-up or learn best techniques for tissue preparation? What can be read?

Beiter: Many hospitals, including ours, have courses in tissue technique. The *Registry of the A.S.C.P.* could furnish a list. Two possible books to read are: *Pathological Technique*, F. B. Mallory, Saunders Co., and *Histopathologic Technic*, R. D. Lillie, Blakiston Co.

Weber: The best way to learn about preparing tissue is not to read books on technique (of which there are some good ones) but to actually do the work in a laboratory, preferably one where very many special stains are always being done. Unfortunately for the technician to be, the growing complexity of modern histological and cytological technique has resulted in the establishment of specialized laboratories everywhere. To become truly aware of the opportunities offered in the special techniques, the student should spend time in the general pathological or histological laboratory and then augment the experience with a stay in the bone pathology lab, the neuropathology lab, the eye pathology lab, in all of which he will find a rich array of specialized techniques necessary for the particular tissue. The following books may also be read: Jones and McClung, *Microscopical Technique* (Hober); Mallory, *Pathological Technique* (Saunders); Gage by and Beams, *The Microtomist's Vade Mecum* (Blakiston); Conn, *Biological Stains* (Biol. Stain. Comm., Geneva, N.Y.).

Mr. Richards: Many university biology or

zoology departments give a semester course in technique. It is an art that is learned by making all the mistakes once only. Other recent books are: Baker, *Cytological Technique* (Wiley); Gray, *Handbook of Basic Microtechnique* and his *Microtomist's Formulary and Guide*.

Q: How well do the new *B & L* negative oculars work with Zeiss and Leitz objectives?

Butterfield: The new oculars have not been tested with many objectives of competitive make. It is safe to assume, I believe, that the results in most cases at least should be good, since it is likely that the corrections are quite similar in objectives of similar focal length and N.A. made by the leading manufacturers.

Q: Why can't a photomicrographic setup be modelled after the electron microscope, illuminating the [illegible] positive centering?

Butterfield: It could be. Some photomicrographic units on the market follow this idea except perhaps that the camera part is doubled back to eliminate a separate viewing system and to permit convenient focusing directly at the film plane.

Weber: The great disadvantage of a taught column would be twofold. First, the constant rise of heat from the lamp would make the working at such a setup uncomfortable and unhealthy for the lens system. Second, the problem of heat falling on the lamp condensers positioned vertically would be a constant source of trouble to the operator. Third, the problem of great length which would be involved could prove a very troublesome factor. There are no real advantages to such a system.

Richards: Cinephotomicrographic units for use with tissue culture have been made with an inverted microscope, and some metallographic microscopes are made in this manner. With any microscope one must weigh the advantages and limitations with reference to the problem at hand or general needs of the department.

Q: Why can't optical manufacturers go into designing better chambers for living tissue cultures from the optical point of view to obtain better resolution in photography of living material?

Butterfield: I believe this problem has been considered by the optical manufacturers, but on investigation the answer has been that optically worked cells are too expensive in comparison with the blown or molded forms which can be discarded when necessary, without much concern.

Weber: I feel that a vast amount of future research will be involved with tissue culture and the phase examination of these living cells. Any improvements in the mechanical microscope which will permit better handling of this type of specimen—mechanical features in the stage for holding petri dishes, etc.; glycerine phase objectives; water immersion phase objectives; and sub-stage condensers able to direct the light through the thickness of a petri dish, will prove of tremendous value to the photomicrographer, not only from the point of view of resolution, but, in many cases, the actual ability to take the very photograph.

Richards: Many kinds of culture vessels have been devised and described in the older books on microscopy. Some are occasionally revived, but few seem to meet the demands of continually improving technique. Maybe these should be designed specially, as needed.

Q: Have the reflecting objectives been successful?

Richards: Catoptric objectives made of mirrors rather than lenses are especially useful for photomicrographs or absorption spectrophotometry with ultraviolet and infrared radiation. Focusing is possible with light, and other wavelengths are also in focus because mirrors do not have chromatic aberration. Some loss occurs from the blocking off of the center rays, the importance of which depends on the size and nature of the specimen. Lens objectives are usually preferable in the visual range.

Q: Will Dr. Richards comment briefly on the new long-working distance objective adaptations such as "catoptric"?

Richards: The *Newton* long focus attachment is essentially a mirror objective placed in front of the usual objective. The mirror objective is designed to have a longer working distance and forms its image (often with unit magnification) within the working distance of the regular objective, so that the ordinary objective can be focused upon this image. It is an optical relay system. Extra optical systems loose some light and rarely improve the quality of the final image, although they make possible special applications.

Q: When using a microscope with a permanent physical setup, what objectives and oculars are available for good low powers, say 25X to 12X?

Butterfield: *Bausch & Lomb* and other manufacturers offer objectives ranging in focal length from 48mm to about 28mm with initial magnifications of 2X to 6X or thereabouts. The new *Ultraplane* eyepiece works well at the low powers. Conventional eyepieces can be used but some of the longest focal length objectives work well without an eyepiece.

Weber: I think that good low powers are best obtained by the low magnification photographic objectives such as: *Microteleplats*, *Microsummars*, *Microtessars*, and *Microtars*. They are especially corrected for a much more satisfactory flatness of field and yield much better low powers than is possible with the conventional objective-ocular combination. The problem here becomes more complicated when 35mm color photomicrographs are desired, in which case the usual microscope arrangement of 5X ocular and 5X objective does not fill the 3 mm area. The use of low magnification photographic objectives, however, demands a separate condenser system for these objectives, but the results are so superior as to be well worth the extra cost and trouble in putting the apparatus together.

Q: In tissue slides with H and E, and Mason stains, is it possible to standardize photomicrographic technique to the extent of using one type film only? Would it be orthochromatic or panchromatic film?

Butterfield: If one were to standardize on a single film, I would suggest *Panatomic X*. It has good contrast, resolving power, color sensitivity, etc. Nevertheless, ortho film types have many uses, for example, with pale Eosin (Y) and dark Hematoxylin.

Weber: The standardization to one type of film is not feasible (regardless of the stain) when the study is of a specific component of the cell or tissue. For example, if the important area is the collagen, staining one color, it will need one film and filter combination to bring it out from its background. If the muscle must be emphasized, the filter and film may not be the same to give the best picture. An H&E stain may be well reproduced with ortho film, but even with this stain combination, when it is necessary to show fine differences in staining intensity in the nucleus or cytoplasm, panchromatic film and different filters may be advisable. Standardization is best, therefore, for the circumstances of a specific project where variables must be kept to a minimum because of other important considerations in the overall research.

Q: How did Dr. Vishniac get the color in his pictures?

Mr. Richards referred this question to Dr. Vishniac, who was in attendance, but he talked around the question. Since he did not reveal his methods, best guesses of the panel were: polarized light with or without tint plates, and combinations with dark field, optical staining, and other methods which give similar colors.

Q: Is 35mm equipment adequate for high quality photomicrographs? If not, what can be said about negative size?

Beiter: Any good equipment is adequate for high quality photomicrographs. However, it is my belief, that if all factors are taken into consideration, consistently good photomicrographs will be obtained most often by most workers with larger than 35mm equipment.

Weber: 35mm photomicrographs have been used in making very beautiful color plates in journals and textbooks. I think it is important to consider the questioner's tolerances here — what is his definition of "high quality"? Therefore, the best answer to what size the negative should be lies in the particular requirements of the individual photomicrographer, or of the laboratory for whom he works. If the laboratory has a great deal of money, and no 35mm projector, they may prefer all their work on 8 in. x 10 in. film.

Q: Since many photomicrographs are made for lantern slides, would it not be practical to make a 3¼ in. x 4¼ in. back for the *Bausch & Lomb* 5 in. x 7 in., *Model L*?

Butterfield: It would be possible, but actually not practical or economical, to make a separate back for the 3¼ in. x 4¼ in. size. It would be necessary to make one also for 4 in. x 5 in. film for those who prefer that size. The 5 in. x 7 in. plate holder with the reducing kits for 4 in. x 5 in., 3¼ in. x 4¼ in. film sheaths or plates offers the simplest answer. Those who do a lot of lantern slide work use the reducing adapters or, they tape a 3¼ in. x 4¼ in. film sheath in the center of a 5 in. x 7 in. holder. A suitable lantern

slide mask fastened to the focusing screen aids in composing the picture.

Q: Why do some people worry about curvature of field?

Butterfield: Both the designer of the lenses and the user are concerned. The lens designer "worries" about the field curvature simply because it is one of the several aberrations he must contend with in developing a lens that will produce a good image over the largest possible area. The photomicrographer is certainly concerned with the curvature in the image from his microscope. I can hardly imagine a photomicrographer who has not been confronted with the problem of including important specimen structure near the edge of the field as well as that at the center and having it all in good focus at the same time.

Q: If you were to train an employee in photomicrography, where would you start? What reading material? What preliminary exercises?

Beiter: Obviously, a sizeable book could be written about this question. In short, I believe in employing as many methods of teaching and learning as possible. The student, for example, should read, attend lectures, take "sketchy" notes and write them up—filling in gaps—as soon as possible. Blackboard diagrams, demonstrations, etc., should be employed by the instructor. In other words, use as many of the student's and instructor's faculties as possible.

Butterfield: I would start with the microscope to the basic principles of photomicrography; function of the optics and the system of the microscope; illumination; etc. Complete familiarity with the microscope is essential, for photomicrography is the application of photography to the microscope, not an application of microscope to photography.

I think C. P. Shillaber in his book outlines a good plan of laboratory practice for the beginner to follow, as well as presenting good reading material.

Weber: I think that the best reading materials are Shillaber's book, Michel's *Essentials in Photomicrography*, Hind and Randall's *Handbook on Photomicrography*, and Bennett, *et al*, *Phase Microscopy*. These give a tremendous amount of information regarding the theory and practice of working with the microscope with stained and unstained (living) specimens. With this as a basis, I think the most rewarding method would be to watch a good technician in action, continually practicing and asking questions. I cannot think of anything better than such a student-teacher relationship, backed by the above reference material. As to where to start, I would have the student turn on the light and look into a microscope. And, without being facetious, I would recommend a trip to one of the big optical manufacturers where he could watch the assemblage of the instruments and become acquainted with the many problems connected with their manufacture. Such a trip would go a long way towards giving him a fuller understanding of the use of the instrument.

Richards: Illuminating the microscope is most important. I would start the beginner on Koehler's method with a good microscope illuminator. If he did not discover the effects of incorrect focus and misalignment, I would then have him do this so that he could recognize correct and incorrect imagery. It is better to practice on the kind of specimens he will work with. Those of Shillaber, mentioned by Butterfield, are also excellent. I would have him read also the Kodak booklet *Photography Through the Microscope* and *Photomicrography*, and selected articles from JBPA, along with the practical work. Real competence in microscopy must be developed before good photomicrographs result.

Standards in Gross Photography*

JULIUS HALSMAN

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Armed Forces Institute of Pathology

Introduction

THE purpose of this paper is to suggest standards for the photographic presentation of gross specimens. The main considerations, in the author's opinion, are 1.) aesthetic effect of the picture, 2.) visual acuity of the observer, 3.) practicability of method in contributing to ease of interpretation of a photograph during comparative study.

Factors to be considered include, a.) picture framing, b.) ratio of specimen size to background area, c.) devices for identification and scaling, d.) background hues, e.) ratio of background luminance to luminance of specimen, f.) overlays, g.) choice of background.

Photographic medical illustration is almost ideal for dissemination of knowledge of pathological conditions, whether by means of published illustrations or lantern slides. Color processes have increased the flexibility of the medium. Photographers can now not only record the approximate colors of a specimen, but can also use color as a control in emphasizing or detracting from the specimen, the only restraints being the inherent limitations of the medium and the personal taste of the photographer.

Serious shortcomings have become apparent, however, with the ever increasing number of gross photographs taken as an adjunct to case histories, with the amassing and interchange of photographs within the medical profession for teaching or publication, with the establishment of large centers for the storage and distribution of these photographs to schools and hospitals, and with the grouping into sets of photographs from various contributors. To become aware of the existing situation it is necessary only to examine critically a set of lantern slides of gross pathology or a modern illustrated medical book to find such shortcomings as: entirely misleading color reproductions; inappropriate rulers, scales, scratched and inked lines, grids and patterns, fingers, cigarettes and various other objects purported to give an indication of size; paper arrows, pencils, and scalpels that supposedly point to significant areas; and often, in the midst of these distracting elements, poor photography of the specimen itself.

Colored backgrounds are frequently used because "they make the picture look good", or "the color is complementary to the specimen". The concept that the gross specimen should be treated as a jewel and placed in a bright and colorful setting does not hold for the most accurate work. If colors are visually strengthened by the use of complementary backgrounds, then the colors within the specimen are falsified. Evaluation is made difficult in comparison to the evaluation of a similar specimen on a background of more neutral color.

A photograph of a gross specimen has only one reason for existence, that is, as a record which visually depicts, simply and honestly, the specimen itself. This record should be easy to view; salient features should be apparent without pointers. Most important, the format should be such as to lend itself to rapid comprehension.

In the preparation of photographs for protracted study or as visual training aids, the format should be given careful thought so that it aids the process of vision. The more elements in view, the more the eyes are distracted from the prime subject, thus, the more conscious the effort required to fix the gaze on the essential area. One property of vision is that the eyes are never at rest. It is this restlessness that makes it easy to lead the eyes away from the important feature of a picture.

However, before discussing vision, *per se*, it may be well to examine the concepts of light and color. "Light is that aspect of radiant energy of which a human being is aware through the visual sensation arising from the stimulation of the retina of the eye. Color consists of the characteristics of light other than spatial and temporal inhomogeneities, color being that aspect of radiant energy of which a human observer is aware through the visual stimulation of the retina of the eye. [illegible] thus defined as psychophysical concepts. This definition should be kept in mind, because while the "eye" is stimulated, this stimula-

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tion is modulated and controlled by the brain (by experience, expectation, emotion and the relationship to one's immediate surroundings) so that what is "seen" is not necessarily a true interpretation of fact.

We are all familiar with the embarrassing situation of hailing a friend and discovering a stranger. A slight similarity and the mind immediately says "a friend" and recalls the person's name. We look at a picture and immediately our "seeing" tells us that there is depth and dimension. We look down a street, and though we know that the street does not become narrower in the distance, yet we see it as if it did and base our estimate of distance on this effect. We go to a motion picture theater and see what looks to be a fully illuminated screen, and motion; yet we know that the screen is completely dark many times a second, and that the motion is an illusion caused by viewing a sequence of rapidly projected still pictures. If we really saw motion, the picture would be blurred.

Figure 1 shows three time-honored visual illusions in which the natural weaknesses of the eye have been exploited to produce misleading effects. These illusions are intended merely as a demonstration of erroneous interpretation of visual stimuli caused by deliberate misdirection of the process of vision. (For further reading on illusions, refer to Bibliography.)

It must be assumed, therefore, that if the mind's eye can be misled by simple lines when the observer is aware that it is an illusion, then a cluttered colored photograph, in which the observer is not expecting an illusion, can be an effective device for creating an undesired impression.

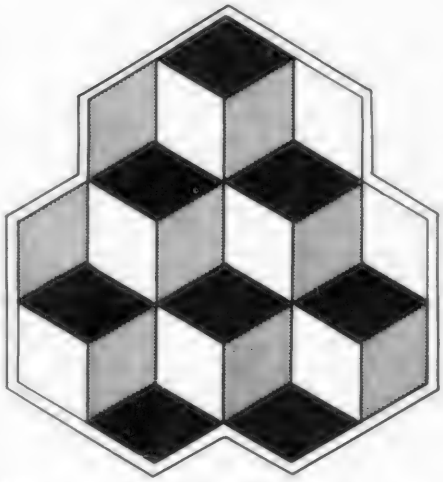

Figure 1(b). After continued gaze the above blocks appear inverted, an illusion apparently causing a sudden shift in perspective.

Postulating Standards

To understand the problems in establishing a standardized method of gross presentation, which must include placement of specimen, background hue and intensity, rules and identifying marks, the requirements of

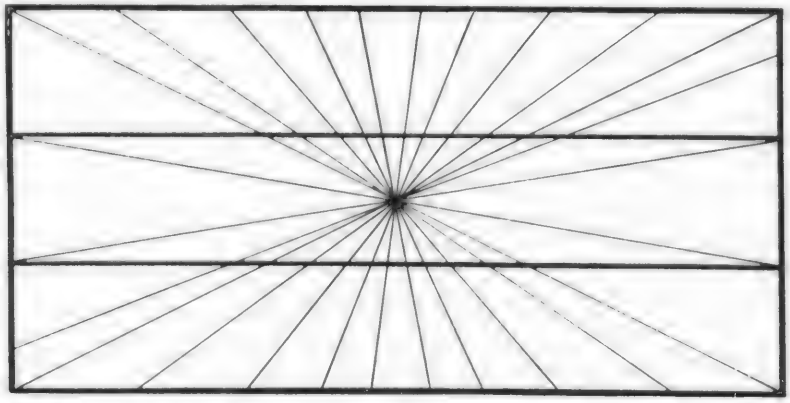

Figure 1(a). Two parallel lines appear curved because intersecting lines misdirect the eye, leading to erroneous interpretation.

a good gross photograph must be kept in mind. These are summarized as follows:

1.) The gross specimen, properly illuminated, must be the primary subject of the photograph.

2.) The background must always be subservient to the subject in hue, brightness and saturation, and must not compete with it for attention.

3.) The background must not falsely affect the interpretation of the specimen.

4.) Included in the photograph must be a device to indicate the exact size of the specimen or areas of trauma. This device should be located so as to indicate the proper viewing position. It must be clear and easily interpreted, but again must not compete for attention with the specimen.

5.) A device to indicate special areas of interest should be used only when needed and must *not* be placed upon the original specimen or be made an intrinsic part of the negative or transparency.

Rules and Guides

In gross photography, rules, guides, coins, spoons, and other objects are often included to indicate size. Such devices are placed on the specimen, above or below it and to the sides of it. The multiplicity of type and placement has tended to complicate what should be a simple demonstration of the dimensions of the specimen. Too many potentially fine gross photographs have been rendered mediocre because of crude methods for indicating size. Since the metric system is accepted in all scientific work, a centimeter rule is the first choice as a visible scale for gross photography.

The ruler has another use when, for orientation of the viewer, it is invariably placed at the anatomic bottom of the specimen. The name of the institution where the photographs were taken can be placed at its lower edge. In general, the ruler should not touch or be superimposed on the specimen. In instances in which a variety of rulers or scales have been used and the photographs are to be component units of a published series, the printer will substitute a standard rule through the entire series. If a rule has been placed on a specimen before photography, it may be impossible to make this substitution or it may even be necessary to crop the print to delete the ruler, thus giving the appearance of a mutilated gross specimen.

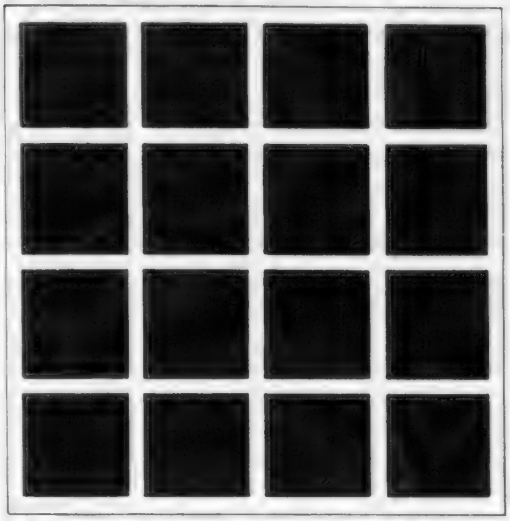

Figure 1(c). Gray areas appear where the white lines intersect.

Since a scale is necessary, the ruler should be placed at the edge of the field and held to a practical minimum size. Some persons may object to the inclusion of a ruler in the photograph on the grounds that an estimate of size can easily be made. Figure 2 is an illusion in which three rectangular solids of identical sizes are estimated by the eye to be of three different sizes. The eye, in the absence of a standard comparison, is entirely unreliable in estimating size or distance.

There are those who will argue that the ruler should be placed as closely as possible to the specimen, or even upon it, so that the size comparison is obvious. However, it takes no effort to place a ruler on a print or transparency for comparison against a reduced or enlarged ruler. Others say that a thumb, a scalpel or a tray should be used to indicate size. There is no denying that a scalpel blade, a tray or dwarfing a thumb is impressive. But in the final analysis how large is the tray — what is the size of the specimen? The answer must be that for a clean-cut, objective and scientific presentation of facts, an inflexible and unmistakable device must be used. A metric ruler is the practical accurate method of size presentation the world over. Three rules of different lengths — 3 centimeters, 6 centimeters and 12 centimeters — were chosen in our laboratory as size indicators for routine gross specimens of average size (Fig. 3). (Some of the

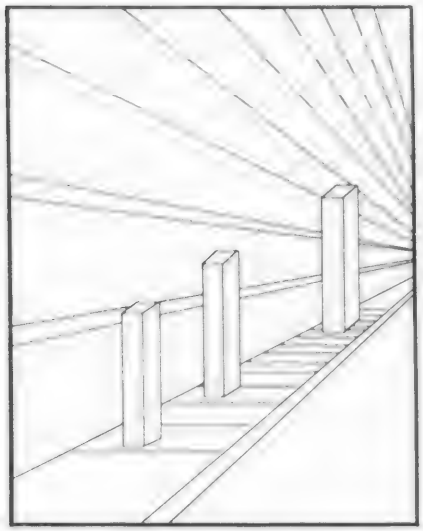

Figure 2. Three rectangular solids of identical size appear of different sizes because of misdirection of the eye by lines which suggest perspective.

rules used are positive film images to blend still further with the background. These are easily read.)

Overlays

There are numerous occasions when attention must be directed to certain details of lesions or areas of trauma on a gross specimen. This has often been done by placing needles, arrows cut from paper, and pencil or pointing fingers on the specimen. The photograph, which in years to come may be of value for a reason other than the immediate one, may be useless because of the [illegible] placed upon it. It is recommended that an overlay be placed on the negative or on the lantern slide, with arrows or pointers inked or taped on the overlay. *Artype* figures may be used, from which either positives or negatives can be made. Ozalid overlays* of this form made on transparent foils may be bound together with lantern slides in black and white or color. This will result in a neat, harmonious form of presentation and, best of all, will allow the removal of all obscuring detail from the photograph.

*See JBPA, Vol. 22, No. 2, p. 79 (1954) for further discussion.

Influence of Surrounding Color on Perception of Hue and Saturation

It is not difficult to understand why it is impossible to analyze a series of photographs or lantern slides of subjects of the same type when each is photographed with a different background color, at varying levels of illumination, and with miscellaneous devices to indicate size. The use of bright colors for background results in a photograph in which the specimen and background are in conflict, each demanding the attention of the observer.

The color sensation arising from a given quality of light is influenced by the color of the light from the surrounding areas. This strictly mental effect is known as contrast enhancement. This effect is extremely important because it causes objects to stand out more prominently from their surroundings. Neighboring colors of relatively high or low luminance appear lighter or darker than they would if viewed separately. Similarly, colors of relatively high or low purity, situated side by side, appear more or less saturated than when viewed separately. The less saturated color may be converted to a complementary color. It is the tendency of each color to impress its after-image upon other colors; therefore, a proximation of red and yellow might make the red seem blue-red and the yellow seem green-yellow. Whenever two colors are compared, the eyes tend to glance back and forth from one to the other. For this reason, a dark color looks darker because of the densitization produced by looking at a light color, and the light color looks lighter because of the resensitization which occurs while looking at a dark color. Other effects are obtained when colored light is obtained from the background. To quote the report of the *Committee on Colorimetry of the OSA*, "It has been recommended that for the most critical work a total neutral background should be used" (when comparing color patches). Of equal importance is the shift in appearance of a color when viewed directly after viewing a different color. This shift occurs because of the adaptation of the observer's eyes to the color of the first object. Ralph M. Evans, in his book *An Introduction to Color*, has this to say: "Suppose the next to the last area viewed is dark green, his (the observer's) eye tends to rise in sensitivity because the sample is dark and the blue and red receptors tend to rise more than the green. Sudden transfer of the gaze to

Figure 3. Three types of metric rule used in gross photography.

the other sample will now make this one appear somewhat brighter and less green because of this condition of eye sensitivity. Suppose it is a medium yellow, it should tend to appear lighter and more orange. The reverse is true on passing from the medium yellow to the green, the blue receptors becoming relatively more sensitive but the total sensitivity being somewhat reduced."

When the eye is exposed to colored stimuli, the sensitivities of the receptors are each reduced in proportion to the stimulus value of each color. For example, if the eye is exposed to a green light, the green receptor and, to a lesser extent, the red and blue receptors are depressed. While the depression lasts, the response from the green receptor is deficient. The adaptation of the areas of reception in the eye when confronted with various colors will result in a depression in sensitivity, with suppression of these particular colors when looking at a different object.

Effects of Varying Intensity Levels

Visual tests have indicated that the criterion of visual acuity is not so much a matter of color as it is coarseness of pattern or shape. Tests also indicate that luminance differences have a great effect on resolution. The primary consideration is the ability of the eye to resolve fine detail, and any variable that influences this ability will reduce the resolving power. One of the most influential variables is the illumination level. At low levels of illumination only coarse forms are distinguishable, but on increasing the illumination level resolution improves until a point is reached at very high illumination levels, where the ability of the eye to resolve fine detail again falls off.

Other important variables affecting resolution are contrast of the detail with respect to the background, sharpness of the subject edges, size of the individual parts of the detail, and stability of illumination. High contrast and sharp edges tend to make it possible to resolve fine detail within limits. Extreme contrast caused by hues, different illumination levels between the background and the specimen, and the use of totally white or black backgrounds will reduce the ability of the eye to resolve the detail. High contrast will make the specimen as a whole stand out from the background, but it will result in "harder seeing" of fine detail within the specimen.

Conversely, backgrounds which match the specimen in luminance value will make the true shape and appearance of the edge difficult to discern, although color may within the specimen itself. Therefore, for optimum luminance a compromise should be

1.	Black print	on	white background	Best Perception
2.	Green "	"	white "	
3.	Blue "	"	white "	
4.	Black "	"	yellow "	
5.	Red "	"	yellow "	
6.	Red "	"	white "	
7.	Green "	"	red "	
8.	Orange "	"	black "	
9.	Orange "	"	white "	
10.	Red "	"	green "	
11.	Black "	"	purple "	Least Perception

Chart from Tinker on effect of color on visual apprehension and perception with the arrangement of the best combinations given from top to bottom.

Table I.

REFLECTANCE VALUES OF VARIOUS BACKGROUND MATERIALS

MATERIAL	REFLECTANCE VALUE	QUANTITY OF 3 PRIMARY COLORS		
		MAGENTA	CYAN	YELLOW
PHOTO BLOTTER WHITE	04	08	03	05
PASTEL RED (GLOSSY)	18	4	45	14
PASTEL GREEN (GLOSSY)	26	22	35	4
MEDIUM YELLOW (GLOSSY)	39	26	9	54
BLUE PASTEL (GLOSSY)	46	54	54	26
GREEN LIGHT (SEMI MATT)	52	45	65	82
ORANGE MEDIUM WARM (MATTE)	57	44	47	42
GREEN MEDIUM BLUISH	61	58	67	93
GREEN DARK (GLOSSY)	72	84	126	15
BLUE MEDIUM (GLOSSY)	79	96	93	73
MAROON DARK (GLOSSY)	126	196	92	199

THESE VALUES ARE BASED ON AN ARBITRARY VALUE OF 0 FOR TOTAL REFLECTANCE AND 1.50 FOR TOTAL NON-REFLECTANCE USING AN ANSCO SWEET DENSITOMETER WITH A STANDARD REFLECTANCE HEAD.

Table II.

established between the specimen and background. Tests have been made to determine whether the background should be lighter or darker than the specimen, and by what amount. Table I gives different color combinations of letters and backgrounds according to ease of visual perception. It must be realized that such tests are based on comparatively coarse subjects — letters, numbers and circles — familiar figures which can be recognized rather easily.

These results show that luminosity differences between the intended subject and the background upon which it appears is of great importance. To quote Tinker: "The data indicate this to be true for (1) the accuracy with which colored dots on a gray background are apprehended, (2) the speed with which material printed with colored ink on colored paper is read, (3) the distance at which words printed in colored ink on colored papers are perceived, and (4) the accuracy with which colored numbers on colored or white papers are apprehended."

While we accept Dr. Tinker's words on apprehension, our research was not directed toward shape outline. We were more concerned with visual acuity pertaining to fine detail within the specimen area. However, Dr. Tinker's chart indicates the effects of various color combinations of coarse subjects upon speed of apprehension.

Determination of Background Exposure

The importance of a proper ratio between specimen and background luminance has been pointed out. The methods in use have been, (a) to illuminate the specimen, and then the background, so that they appear evenly illuminated, (b) to pay no attention to the background and depend upon its illumination to be derived from the light that spills over from the specimen illumination. However, the background is an important part of the photograph and should be handled as such: that is, the background should have a complete set of lights, and as much care should be given to its exposure as to that of the specimen.

Before proceeding further it is apropos to consider the reflectance values of various background materials. It is apparent that despite the chroma, hue and saturation of the background, the type of material (glossy, dull or matte) has a great effect on its ability to reflect light. Tests made by means of an *Ansco Sweet Densitometer* (with reflectance head) provided data for Table II.

IF SPECIMEN'S LIGHT (WESTON) VALUE IS	BACKGROUND REFLECTANCE VALUES 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	BACKGROUND LIGHT VALUE MUST BE
100.	2/5	1/2	2/3	4/5	1 1/4	1 1/2	2	2 1/2	3	4	100.
50.	4/5	1	1 1/4	1 1/2	2 1/2	3	4	5	6	8	50
25	1 1/2	2	2 1/2	3	5	6	8	10	12	16	25
13	3	4	5	6	10	12	16	20	24	32	13
6.5	6	8	10	12	20	24	32	40	48	64	6.5
3.2	12	16	20	24	40	48	64	80	96	128	3.2
1.6	24	32	40	48	80	96	128	160	192		1.6
8	48	64	80	96	160	192	256				8
4	96	128	160	192	320						4
2	192	256	320								2

To use this scale read specimen as is normally done. Find specimen light value in left hand column. Set background light intensity as indicated in extreme right column with specimen lights still on. The figures in the various columns indicate background exposures dependent upon their reflectance values and the proper background light value and normal specimen exposure.

Table III.

Ratio of Background Exposure to Specimen Luminance. Film speed, Weston 8 or A.S.A. 10

Tests then made with a gross specimen camera "set-up" (in conjunction with gross specimen readings) provided enough data for the formulation of an illumination ratio scale, relating the gross specimen illumination to the illumination level of the background (Table III). This scale enabled our photographers to photograph light specimens upon a comparatively light ground and dark specimens upon a dark ground, regardless of the background color of the material. Testing of the backgrounds was carried on objectively without consideration of personal color preference. The sole criterion was the gain in visual acuity. The comparison backgrounds were three values of gray. The pigment used was a lacquer manufactured by DuPont, known as "thistle" gray.

Black-and-White Photography

The problems in black-and-white gross specimen work are identical to those of color, except the obvious one of background hue. Since totally white or black backgrounds result in effects which increase contrast between the specimen and background, and could affect the ability of resolution, it is recommended that a background of a reflectance value of 10-20 per cent be used in the same manner as for color work (the same charts, "ratio of background exposure to specimen luminance", may be used by simple conversion of the film speed).

Summary

Basically the problem-question in gross specimen photography is: should the specimen be photographed in a manner that will feature the specimen as an individual photograph, or should the specimen be photographed as a unit that can be included in a standardized work to be used for comparative study?

With a precedent of standardized work for reference, gross specimen photography can be practiced in a standardized form, despite strong personal preferences of clients for various backgrounds, pointers, rulers, etc. Samples of colored background material for use in standardization tests may be obtained from art or window display manufacturers or a chart containing the reflectance values and the required percentages of three basic colors may be used to produce them.

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Photography of the Newborn*

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ALL hospitals with maternity divisions can have not only self-supporting, but profitable Departments of Medical Photography by simply doing routine photography of all newborn.

Many hospitals have taken photographs of the newborn for years, some profitably, but the majority just breaking even. I should like to show how a baby picture service, when properly operated, can pay salaries and other costs and make a worthwhile profit.

For five years I have operated a Medical Photography Department at the Methodist Hospital of Dallas, a 350 bed general hospital with a maternity division averaging 3000 babies per year. During this five years my department has made in excess of $75,000 on baby pictures. This is approximately $1250 per month, or $15,000 per year.

The income pays my salary and that of one assistant as well as all cost of supplies and equipment. It has provided enough profit to enable us to do all the work we wish for our teaching program, and also plan expansion of the department in the near future.

Medical photography for use in our teaching program, for both house staff and school of [illegible] and outside staff meetings, is charged on a departmental basis. For work done outside the hospital the doctor is charged very low rates; an impossibility without the baby picture service.

Many administrators feel that a baby picture service is too commercial and will be resented. Contrary to this belief I have found it to be one of the best public relations gestures a hospital can make. Not only are the photographs appreciated at the time of purchase, but they become one of the parents most cherished possessions. Over 90% of the parents order photographs.

Photographs of the babies are made in the nursery once a day, by myself or my assistant, using an electrically operated 70mm *Beattie Portronic* camera and strobe unit that is mounted permanently on the wall (Figure 1.) This camera is also available in 35mm. However, I advise the use of the larger film since quite frequently retouching of bruises on the face and arms is necessary. The photographs are taken after rolling the bassinets to a marked position under the camera.

With this type of camera the nursery personnel can be trained to take the photographs. I feel it advantageous, though, to have the photographs taken by photography personnel. The position of the baby within the small bassinet is very important in the final composition of the photograph. The facial expression and position of the arms are two other most important factors. Quality of the photographs determines the success of this service.

The babies permanent negative envelope and order form is made in the nursery prior to the shooting. This envelope, inserted in the identification slot of the camera, records the name on each negative. Two negatives are made of each baby for safety. Quite frequently we work with a "high-speed" subject that makes photography quite a [illegible]. Photographs are made of all babies in the regular nursery. Premature babies are not photographed until they are transferred to the regular nursery.

After each day's shooting, the exposed film magazine is removed and taken to the laboratory for processing. The exposed film is taken from the magazine and processed on an aerial film roller assembly. The photographs are taken here, beginning at 8 a.m., and processed immediately after the last exposure. Upon choosing the best of the two negatives a 5 in. x 7 in. matte print is made from each. The prints are placed in folders embossed with the hospital name. At 2 p.m. (visiting hour) the prints are taken to the mothers. Orders are taken at this time, and the charge is $4.50 for 5 in. x 7 in., and $1.00 for billfold prints. Additionally ordered prints are mailed to the parents later.

*Received for publication May 29, 1955.

Figure 1. Electrically operated 70 mm Beattie Portronic camera and "strobe" unit for photography of the newborn

Figure 2. In showing finished photographs a pleasant disposition is important.

Experience has shown that personal contact with the mother is best handled by a girl assistant. A pleasant disposition and a friendly approach in showing the photographs are essential. (Figure 2.)

I hope that this information will be helpful to many who already have photography departments, but my primary reason for this brief description of our activities is my interest in seeing more medical photography departments established in smaller hospitals thereby increasing the scope of medical photography, and opening new positions for photographer

BOOK REVIEWS

HISTOPATHOLOGIC TECHNIC AND PRACTICAL HISTOCHEMISTRY, *R. D. Lillie, The Blakiston Company, New York, N.Y., 501 pages, Illustrated, 6 in. x 9 in., (1954) Cloth bound, $7.50.*

The second edition of Histopathologic Technic has a longer title, 201 more pages and reflects the progress since 1948. Much of the increase is additional material and methods on histochemistry. The short chapter on decalcification is combined with Hard Tissues, and two chapters, on Nuclei and Nucleic Acids, and on Amino Acids End Groups, etc., replace the Nuclear Stains chapter of the first edition. Buffer solution tables are doubled and the index has been expanded accordingly. Machine processing of large numbers of specimens is described. Abbe's name is still misspelled. A few minor errors need correction, as on p. 12, the dark top should be 16.6 rather than 166mm. As to refractive index the usual convention for refractive index there seems little point to use nΔ. The book is written in a personal style and the author's comments are helpful and reflect experience with the methods. They save it from being encyclopedic. Yet an amazing amount of material has been brought into one volume. It could become the most useful reference in many Technic Laboratories. O.W.R.

LABORATORY IDENTIFICATION OF PATHOGENIC FUNGI SIMPLIFIED, *Elizabeth L. Hazen and Frank Curtis Reed, Charles C. Thomas, Publisher, Springfield, Ill., 108 pages, 7 in. x 10 in., (1955), Illustrated, Lexide bound, $5.50.*

This monograph is the result of teaching diagnostic methods for fungi in the Laboratories of the New York State Department of Health, to students and visitors who have had training in bacteriological technics. The mycoses are divided into the superficial and deep seated, with about equal space to each. A genus is taken, a general discussion of its importance given and the basic identification features described, often by means of a table. Photomicrographs, sketches and photographs of the colony growth complete the descriptions. In the larger genera this is also done for the more important species. Genera treated include: Microsporium, Trichophyton, and Epidermophyton in the superficial group, and Actinomyces, Nocardia, Blastomyces, Candida, Coccidiodes, Cryptococcus, Geotrichium, Histoplasma, Monosporium, Sporotrichium, and 4 genera of the Chromoblastomycosis group. Formulae for the basic culture media are given and selected references are provided for each genera or disease entity. While considerable material is included the monograph has been condensed to a practical level. The treatment shows the results of actual teaching and time alone can tell whether it is adequate or will need be elaborated. There must be some level between the research literature and needs of the biologist and physician. Perhaps for that object this manual is it. O.W.R.

PHOTOGRAPHIC PRODUCTION OF SLIDES AND FILM STRIPS, *Eastman Kodak Company, Rochester, N.Y., Data Books, (1955), Illustrated, Paper Covers, $0.50.*

A new Kodak Data Book designed to help the medical or dental photographer carry out the necessary steps in transforming flat copy and photographs to a filmstrip or slide sequence has been issued by the Eastman Kodak Company. This new book will assist photographers to supplement the slides and film strips prepared by commercial producers with presentations planned to fit a particular program for their own schools, hospitals or associations. Procedures and techniques are listed to make possible the production of such presentations in small quantities at relatively low cost with conventional photographic equipment.

The data book begins with an outline of procedures recommended with page references to more detailed descriptions of techniques which follow. In a second section, master prints, photographing flat copy, making black-

and-white positives, preparing color transparencies, making duplicate color transparencies and addition of titles are discussed in detail. Data sheets for films and plates used in the processes including Ektachrome Types B and F, Kodachrome Type A, Ektacolor Print, Direct Positive, Fine Grain Positive, and Kodak Lantern Slide Plates are provided. Of special value to the photographer is a listing of some of the companies which supply equipment useful for slide and filmstrip production such as cameras and accessories, printers, and processing equipment.

35MM PHOTOGRAPHY WITH A PRAKTIFLEX, *R. H. Bomback, Variety Books, P.O. Box 97, Bronxville, N.Y., 127 pages, (1955), Illustrated, $3.00.*

Prakticon Corporation has sponsored a new book on 35mm photography with a Praktiflex by R. H. Bomback. This book explains the mechanics, techniques and applications of the Praktiflex Camera. Every phase of Praktiflex photography is described in 127 pages. There are chapters dealing with portraiture, nature studies — including photographing flowers, animals, insects. Other subjects discussed and illustrated include sports, pictorial, aerial and commercial photography with the Praktiflex. The use of Novoflex bellows, extension tubes, copying of letters and documents is clearly explained and illustrated. There are over 90 photographs illustrating the subjects described by the author.

CINE-KODAK AND KODAK HIGH-SPEED INFRARED FILM, *Eastman Kodak Company, Rochester (1955), Free.*

New data on the Cine-Kodak and Kodak High Speed Infrared Film has been prepared by the Eastman Kodak Company and is now ready for distribution. An idea of the high-speed of this new film is gained from its tungsten exposure index with Wratten A filter, of 160. Punched to fit the Kodak Photographic Notebook, the bulletin offers complete information on loading and unloading, exposure, filters, processing, storage, sizes available, and sensitometric data on the film, which is sensitive through the visible spectrum and into the infrared to approximately 9000A with maximum sensitivity in the region from 7700A to 8400A. Available without charge from the Sales Service Division, Eastman Kodak Company, Rochester 4, New York.

SPECIAL EFFECTS IN CINEMATOGRAPHY, *H. A. V. Bulleid, Fountain Press, London, 256 pages, Illustrated, (1955). Available from Rayelle Publications, 5700 Oxford Street, Philadelphia 31, Pa., $4.75.*

This book is concerned only with 8mm, 9.5mm, and 16mm motion picture photography, and is intended primarily for the amateur. Effects produced in the camera by lens manipulation, varying camera distance, movement and speed, animation, superimposition, split screen, optical effects, titles, stills and models, use of mirrors, modifications after processing, fades and wipes, faking weather recording and special sound effects are treated.

RESEARCH FILMS IN BIOLOGY, ANTHROPOLOGY, PSYCHOLOGY AND MEDICINE, *Anthony R. Michaelis, Academic Press, Inc., New York, (1955), 490 pages, 6¼ in. x 9¼ in., illustrated, cloth bound, $10.00.*

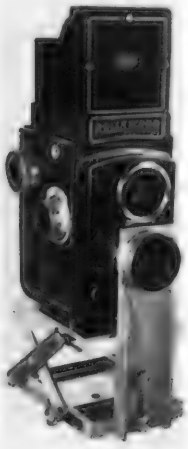
Anthony R. Michaelis is Technical Director of Scientific, Industrial and Medical Photographic Laboratories, Ltd., in London and very well qualified to write a book on research films. He is both a scientist and cinematographer and has directed his treatment to aid those in either group.

The introduction to the book concerns scientific cinematography and the research film. Although brief, the historical background is presented in a very readable, scholarly fashion. Dr. Michaelis has the knack of coming up with some very interesting, and sometimes surprising, bits of detail which give evidence that he has studied all aspects of his subject thoroughly. But it is regrettable that the excellent historical book on the development of cinematography by Georges Sadoul (in French) and J. Millingham (in Spanish) are not cited among the author's 1490 references.

Part 1 of the book treats cinematography in various areas of biology. Part 2 deals with the human sciences, and Part 3 with the medical fields. Equipment, techniques, limitations, theory, etc., are clearly and completely set forth. This book is highly recommended to medical and biological photographers.

New Products

TWIN LENS CAMERA ADAPTER



An improved adapter [illegible] has been introduced by Waring Cleveland Instrument Company [illegible] Cleveland, Ohio. A [illegible] ment, this adapter, called [illegible], allows any twin lens reflex camera to be used for closeup [illegible] photography and copy [illegible] this equipment is that parallax between the [illegible] lens and the [illegible] use, the focusing and [illegible] lens. Vertical raising of the table moves the taking lens into the previous position of the [illegible]

HASSELBLAD SUPERWIDE CAMERA

The new Hasselblad Superwide Camera [illegible] specifically created by Carl Zeiss for this camera, takes wide-angle pictures up to 90 degrees. With the camera the photographer can take in sweeping heights and ex[illegible]

BOLEX ANNOUNCES NEW C-8 CAMERA

The Bolex C-8 is a new compact single [illegible] Products, Inc., 100 Sixth Ave., New York, N.Y. It features a full range of speeds from [illegible] posures for trick work. The footage counter [illegible] conveniently located in the back next to the viewfinder. A zoom type viewfinder shows the field of view for lenses from ½ in. to 1½ in.; wide angle finder and parallax correction prism available as accessories. Other features are instant run down stop, continuous run lock, audible film end indicator, and standard D lens mount. Price, according to lens, $89.95 to $179.95

Price: with Lytar ½" f/2.5 fixed [illegible] Yvar 13mm f/19 focusing mount. $139.95 Lytar ½" f/1.5. $179.95.

PROFESSIONAL MODEL EDITOR

[illegible] ecto-Editor has been announced by the [illegible] manufacturers of Craig Movie Editing Equipment. This new model includes the large screen Craig 16mm Motion Picture Viewer, Craig Master Rewinds with a capacity for [illegible] reels, the Craig Master Splicer and Craig Formula No. 7 Film Cement all mounted [illegible] Among its features is its large 3¼ inch x 1¼ inch ground glass screen. Movies show [illegible] watt projection lamp is cooled so that fr[illegible]

by frame selection of scenes is possible without danger of overheating the film. Structure has a cold light automatic lamp switch, focusing and framing [illegible] and built-in frame counter and additional features that make movie viewing and editing faster and easier. Price, $79.50.

CINEPHOTOMICROGRAPH TIME LAPSE ASSEMBLY

The Electro-Mechanical Development Co., [illegible] bissonnet, Houston, Texas, has designed [illegible] film can record 4000 images at the rate of 16 frames per minute or less. A thirteen page descriptive bulletin is available upon request which gives complete technical specifications and prices.

KODACHROME FILM WITHOUT PROCESSING CHARGE INCLUDED

[illegible] that effective October 1, 1955 its Kodachrome [illegible] charge included in the price. This change in the sale of Kodak's color roll film is being made, Kodak officials said, in accordance with the terms of the Federal Court Decree of December, 1954. Under this decree [illegible] others to process Kodachrome film. Kodak [illegible] terms used by the company in its own commercial processing and printing operations.

Kodak will continue to operate its processing laboratories and will offer a processing service for the film it produces but will charge separately for its processing service. The company concurrently announced its schedule of prices for processing Kodachrome roll film, and stated that it would handle such [illegible] Kodachrome film already purchased by users with a processing charge included in the [illegible] processing by Kodak directly from customers and no extra charge will be made for the processing. Film sold without a processing [illegible]

[illegible] Kodachrome sold without a processing charge, [illegible]

The familiar yellow return bag used to mail [illegible] is being replaced by a new green bag intended solely to facilitate the return of exposed film to dealers. This new green bag is not [illegible] dealers who may wish to have their customers mail their exposed film while they are [illegible]

[illegible] nounced by Kodak in recent months regarding the sale and processing of color film. On January 1 the company placed an improved type of Kodak Ektachrome film on sale in the 35mm and 828 sizes. This film

[illegible] Marked without a processing charge in order to the price. On July 1 the company announced additional roll film sizes of the [illegible] Kodak Extachrome [illegible] Set [illegible] The company announced [illegible] materials and processing chemicals for the [illegible] of color prints from [illegible] negatives and color negative films. And on September 12, the company announced the availability of the processing chemicals and materials used by the company itself for the [illegible] and [illegible] and [illegible] films.

Along with the present announcement Kodak informed its dealers that it was making a change in the type of Kodachrome film recommended for picture taking with artificial light. This change, which results in the replacement of Kodachrome Film, Type A, with Kodachrome Film, Type [illegible] involves a slight change in the color balance of the product. This change better [illegible] Kodachrome film for picture taking with flash, the most popular type of artificial lighting used by amateur photographers. The company also stated that it would no longer offer Koda[illegible] which has been sold for use by stereo camera owners. The need for [illegible] 35 spooling, the company said, no longer exists now that the processing and mounting charge formerly included in the 35 price are to be paid for by stereo camera owners. Stereo camera owners can easily use Kodachrome 135 roll film and order their stereo mounting separately at the time the film is delivered for processing. In addition the regular spoolings of Kodachrome [illegible] stereo camera owners will obtain 15 stereo pairs from the 20 exposure Kodachrome [illegible] stereo pairs from the [illegible] exposures.

The new Kodachrome Film prices [illegible] 135 Kodak 20 exposures, $2.[illegible] exposures, $2.[illegible]

The following schedule of prices has been established by Kodak for processing [illegible] by a customer and/or dealer to be [illegible]

[illegible]	[illegible]
[illegible]	[illegible]
Kodachrome 135-20 in stereo mounts	[illegible]
Kodachrome 135-20 Processing only (unmounted)	1.[illegible]
Kodachrome 135-36 in 2 x 2-inch mounts	2.5[illegible]
Kodachrome 135-36 in stereo mount	[illegible]
Kodachrome 135-36 Processing only (unmounted)	2.5[illegible]
Kodachrome 828-8 in 2 x 2-inch mounts	1.00
Kodachrome 828-8 Processing only (unmounted)	[illegible]

These prices and changes apply to the United States and the specific spoolings noted only.

KERN COLPOGRAPH

Mr. V. Van Veen, Kern Company, 5 Beekman Street, New York 38, N.Y., has advised that his firm is the American importer for the microscopic and other scientific equipment of [illegible] and. Among items of interest to medical photographers is the Kern Colpograph with electronic flash attachment. However, [illegible] ways and special accessories are available [illegible]

"DH" DEHYDRATED EMULSION NOW AVAILABLE THROUGH DEALERS

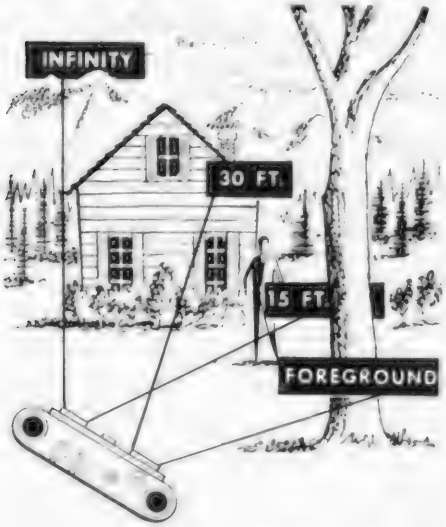
[illegible] used by the Du Pont [illegible] industrial product only. [illegible]

[illegible] cover approximately 100 square feet; one [illegible]

NEW STEREO CAMERA SAID TO BE BASED ON UNIQUE LENS SYSTEM

A new type of lens system that eliminates focusing is embodied in a new stereo camera announced by Graflex, Inc., Rochester, N.Y.

focus automatically from near-foreground to



approximately 30 feet, while the other lens is positioned for focus from approximately … feet to infinity. According to the Graflex announcement, the ability of the human eye …

lar accommodations — causes the stereo slides … a viewer. As a result of the system, Graflex claims that they have been able to produce a simpler Stereo camera, which has only one dial to set: a diaphragm selector for "brilliant", … tions. Operating the camera is then a matter of clicking the shutter and winding the film.

… many shots remain. Precision-made of light-

… combines rugged construction with extreme … a new stereo viewer which provides dual to-

NEW POLAROID LAND CAMERA

… bracket for pictures was unveiled by Polaroid … pictures - - the same size as turned out by the firm's Speedliner and Pathfinder models. (A … produces smaller wallet-size prints).

lubricated bearings, a universal flash guide that shows at a glance the settings to use with any of Polaroid's four films, a new gray finish, new heavy-duty shutter and a new front plate. The bounce-flash bracket, made of chrome-plated steel, fits the accessory clip on the camera and holds the flash gun in either of two positions, for horizontal or vertical pictures. Flash from the lamp can be bounced off the ceiling or wall to produce evenly and softly illuminated pictures that appear to have been taken in natural room light. "THE 700" Polaroid-Land Camera lists for $125.00. In addition to the bounce-flash bracket, newly-designed accessories for "THE 700" include: the Polaroid Powerflash (Model #240), a battery-capacitor gun styled in gray and chrome. Price, including bracket, $15.95, the Polaroid "De Luxe" Compartment Case (Model #309), $24.95.

NEW KODAK CAMERA FOR MEDICAL USE

A new Kodak Retina IIIc Camera which is said to be well suited to use in medical photography has been introduced by the Eastman Kodak Company. The camera features a lens new design in that the front component of its lens may be changed to provide [illegible] quality. This feature which differs substantially from completely interchangeable lenses

of, in effect, gives the same result permits retention of the camera's rangefinder between-the-lens shutter, which has 10 shutter [illegible]. The interchangeability of the lenses, together with attachments, such as a supplementary close range and viewfinder kit, make possible extremely accurate photographs at a wide range of distances down to 11½ inches and with varying fields of view. Another feature of the new Retina IIIc is a built-in exposure meter providing light value readings which are directly transferable to the diaphragm adjusting ring. This ring is coupled to the shutter. Once the light value, as read from the meter, is set, proper exposure is automatic regardless of shutter speed or diaphragm opening. The camera also incorporates a rangefinder combined with a new finder; and a new rapid film advance lever located on the bottom of the camera. Standard lens is a Retina Xenon C lens, 5 cm., f/2. The camera takes standard 35mm cartridges. Price, $185

ANSCO DECIMAL SERIES FILTERS

Ansco is now marketing a new series of yellow, magenta and cyan printing filter foils, with decimal-system calibrations. These [illegible] the company's [illegible] sating filter foils for color printing on Ansco Color Printon. The new decimal series filters vary in color density by a factor of two. For example, the new .5Y yellow is twice as [illegible] as the .1Y, the 1Y is twice as [illegible] as .5Y and so on.

The new filters will be supplied in 4" x 5" [illegible] x 6¾ and 8" x [illegible] sizes in a range of seven densities, to permit accurate control of the color reproduction. They are available individually and in sets. A Conversion #11 and a UV16P Filter [illegible] be supplied [illegible].

[illegible] sets of 7 foils [illegible] color [illegible]

NEW DU PONT SILVER HOME PROJECTION SCREEN MATERIAL

A new silver screen [illegible] for [illegible] projection is [illegible] proved manufacturing [illegible] by the Du Pont Company. Called [illegible] Fabrilite silver [illegible] screen material, it is an aluminum [illegible] coated fabric [illegible] greater durability than beaded projection screening. It also provides better reproduction due to superior light reflecting properties, sharper definition and more uniform projection surface. Moreover, the washable screen will [illegible] with [illegible]. There [illegible] be raised

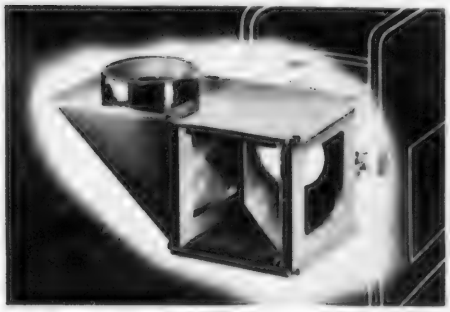
[illegible] "Radiant Manufacturing Company [illegible] Radiant will feature the material in their new "Colormaster" screen designed especially for stereo and color projection.

ANSCOCHROME NOW AVAILABLE IN 16MM MOTION PICTURE FILM

[illegible] new high-speed color film, Anscochrome, is now being supplied in 16mm daylight type motion picture film. Anscochrome [illegible] more than three times as fast as previous cine color films. It is available in 50 foot magazines and 100 foot rolls. The new film's high speed allows a wider variety of subjects and [illegible] to be used in dimly lighted areas, at high frame speeds. Prices: 50 ft. magazine, $6.95 [illegible] ft. rolls, $10.40. Processing is included in these prices.

DU PONT CRONAR BASE LICENSED TO KODAK

The Du Pont Company has announced that they have licensed the Eastman Kodak Company to manufacture polyester photographic base and film under Du Pont patents. Du Pont's trademark for their photographic film base of the polyester type is "Cronar." [illegible] tests have proved the new base to be outstanding in clarity, toughness and dimensional stability. Large scale production of the new base will begin soon at Du Pont's Parlin, N.J. plant.



SPECIAL EFFECTS ATTACHMENT

The Davis and Sanford Co., 23 Avenue E, New Rochelle, N.Y., now offer a special effects attachment for motion picture cameras, [illegible] the 3V for [illegible] intended for "trick" and other special effects [illegible] Close-ups and [illegible] be taken simultaneously, ghost effects and various other image superimpositions are [illegible], etc. A booklet describing in detail the [illegible] available from the manufacturer. Price, $1[illegible] For applications in medical and biological photography, address communications to "Ed Desk of Davis and Sanford Co., addit[illegible]

HIGH-SPEED ANSCOCHROME AVAILABLE IN SHEET FILM SIZES

[illegible] the new high-speed color transparency film which was released in [illegible] is the standard tested film in Many [illegible] available in sheet film sizes, in both daylight and tungsten types. Anscochrome is the first new high-speed color transparency film to be supplied for sheet film cameras. It will open new opportunities for [illegible] photographers who want the [illegible] rapid-action subjects as well as pictures of truer color quality and realism under [illegible] will simplify medical, scientific and technical [illegible]

Anscochrome sheet films will be sup[illegible]

ANSCOCHROME BULK FILM IN DAYLIGHT LOADING PACKAGE

[illegible] transparency film in bulk in a unique daylight [illegible] exposure lengths of 35mm Anscochrome [illegible] and notched. The new package [illegible] Empty 35mm magazines [illegible] with a knob on the side of the [illegible] The Anscochrome [illegible] Loader is factory-dated and factory-sealed in a special climate-proof foil and plastic pouch to assure freshness.

Your Association

A section of the Journal devoted to official announcements, chapter events, and other matters of historical significance to the Association.

CHAPTER NEWS

L. B. Brown, Chairman, Chapters Committee.

Boston: On March 22 the Boston Chapter was invited to the Dormitzer Electric Co. in Cambridge. Mr. Henry Dormitzer was the gracious host and brought us up to date on recent developments in electronic flash. It was an extremely pleasant and instructive evening. Part I

On April 26 we went to the Optical Shop at Massachusetts Institute of Technology where Mr. Hall demonstrated lense grinding from raw glass to finished optics. Mr. Hall

Boston Chapter members at the Dormitzer Electric Company. Left to right are: Mathew Carrigan, Henry Dormitzer, George Buchanan, Donald Withee and David Feigenbaum.

does this exacting work with such ease that each of us were sure we could rush home and polish off a few lenses

The final meeting of the season was held in the Department of Legal Medicine of the Harvard Medical School. Dr. Richard Ford demonstrated the use of color photography in Medico-Legal investigation. This was a most impressive demonstration

At the same meeting Helen C. Harding (Mrs. Ferdinand R. Harding) was made an Honorary Member of the Boston Chapter, BPA in recognition of her faithful support to this Chapter over the years

Southern California: At the Los Angeles County Museum on March 24, Mr. Erwin Verity, background production manager for Walt Disney, discussed "behind the scene" problems

On April 19 Mr. Jack Stoops of UCLA Art Department spoke about "Design in a Photograph".

On May 19 Avis Gregersen shared her experiences in the Republic of Panama with members of the Chapter. The pictures were called "Green Gold" or "The Land Divided, the World United"

On June 23, two 16mm motion pictures were shown by Dr. William T. Zimmerman entitled, "Total Pulmonary Resection" and "Radical Phlebectomy". At this same meeting a photographic raffle was held—prizes being "something of use in your darkroom or studio

Chicago: Mr. Mervin LaRue, Sr. and Mr. Peter Butzen were the hosts at the March meeting. The subject was "Medical Animation" and a newly constructed animation stand was demonstrated. At the business meeting new officers were elected as follows:

President	Paul Jorgensen
Vice President	Maria Ikenberg
Secretary	Dorothy Pinkham
Treasurer	Charles Lindsay
Directors	Evelyn Palmer
	Louis Pedigo
	Frank Marek

The April meeting was held at the Illinois College of Medicine. Tom Jones, outstanding in the field of medical and dental illustration, spoke on "Illustrative Quality in Medical Photography". Julius Halsman, Chief of the Armed Forces Institute of Pathology, spoke about "Standardization of Gross Specimen Photography".

The May meeting was held at the University of Illinois College of Medicine and the subject for the evening was "Modern

Methods for Microscopy" presented by Dr. Oscar W. Richards.

In June there was a round-table discussion of "Cost Finding in Medical Photography". Lou Pedigo was the moderator.

Philadelphia: New officers have been elected as follows:

Chairman	Edward F. Glifort
Vice Chairman	Lewis J. Sunny
Sec.-Treas.	Margaret Engel
Delegate to B.P.A.	Allen Hancock

Prairie: Welcome to the 15th Chapter of the B.P.A. Charter was granted to this chapter at the April Meeting of the Board of Directors. Officers are as follows:

Chairman	William H. Campbell
Vice Chairman	Kenneth S. Carnes
Sec.-Treas.	Bernard M. McGinnis

Regular meetings are scheduled to begin in the Fall of 1955.

25th ANNUAL MEETING OF B.P.A.

Although a full report on the 25th Annual Meeting of the Association cannot be given in this number of the Journal, the number has been sufficiently delayed to allow us to record many of the highlights of the meeting.

Leo C. Massopust, Marquette University School of Medicine, Milwaukee, Wisconsin, was General Chairman. His committee chairmen were: H. Lou Gibson (Program) and Chester Reather (Salon) who were assisted by local chairmen Pierre J. Le Doux and Fred W. Faust.

FIRST BUSINESS MEETING

The meeting convened at the Wisconsin Hotel, Milwaukee from August 30 to September 2, 1955. At the first business meeting held August 30 Leo Massopust welcomed B.P.A. members and guests to Milwaukee and introduced the Rev. E. J. Drummond of Marquette University, who opened the meeting with a prayer. Mr. Massopust then introduced Dr. John S. Hirschboeck, Dean of the Marquette School of Medicine, who welcomed all members on behalf of the University, stating that for many years the University has had a deep interest in the field represented by our Association. Dr. Hirschboeck was pleased that we had chosen 1955 for coming to Milwaukee, since this marked the 75th Anniversary of Marquette University.

He announced that the University had been thinking of the possibility of establishing a 4-year course leading to a Bachelor's degree in biological photography, and plans are now underway for such a course with the hope that it will be ready for its first class in September 1956. It is the University's feeling that there is a need for a full academic degree program in this specialized field. With the leadership of Leo Massopust and others in the field of biological photography, they are of the opinion that a fine course can be built and it is their hope that B.P.A. can look with interest upon the plans and offer suggestions to Mr. Massopust before the course work is formalized. It is their sincere desire to meet the needs of biological photography and establish a truly qualified program.

On behalf of the Wisconsin Chapter B.P.A., Mr. Michael Maradik, President, welcomed the members.

President's Address

Mr. Sturgis advised the membership that it has always been his conception that B.P.A. exists for its members and it was his hope that the membership felt that we have taken steps that will be of benefit to everyone. The first of this year the Secretary's office in New York City was established. This is a step forward for the Association. In the past years we have relied on whatever help could be given - with the donated services as Secretary of Anne Shiras, Lloyd Varden, and Jane Waters - but it became apparent that there was a need for a Secretary's Office with a permanent secretary. Mr. Sturgis was happy to advise that the office is functioning very satisfactorily. The Secretary answers all letters that come in, keeps all official records of the Association, assists the Journal Editor, and has been able to take a great load off the President's hands. She has also relieved the Treasurer of a great part of the work and is now handling all subscription transactions. The back issues of the Journal have now been deposited in the Secretary's office. The Secretary is in the process of collecting material for the Manual of Procedures. Our Sustaining Members have increased, by reason of her regularizing all manufacturers whose product have been listed in the Journal.

The second important step has been the [illegible] our new Constitution and By-

Laws. This was submitted to the Board of Directors, and after approval was sent to all members.

In connection with chapters, the newly formed Prairie Chapter (Kansas) now brings our total to 15. There are two or three more chapters in the process of being organized.

An excellent exhibit was prepared for the A.M.A. and shown at their recent Atlantic City convention. Those who saw it will agree that it was outstanding; it was not pretentious but reflected a straightforward scientific approach. This exhibit will be set up at Marquette University, and can be seen by the membership. It will be shipped around the country to our various chapters.

The insurance plan is working very successfully. A representative from the Joseph K. Dennis Company will be on hand to answer any questions pertaining to our group plan. Mr. LaRue heads this committee.

The Standards Committee has been reactivated under C. Graham Eddy. Past work of the Education Committee and Certification Committee will be coordinated under the Standards Committee. Much work has gone into the background from which Mr. Eddy has drawn a framework for certification. Shortly the membership will be presented with a practical and definite plan whereby certification of its members may be accomplished.

We are now an Affiliate member of the American Institute of Biological Sciences and are a member of the National Society for Medical Research. Mr. Sturgis introduced Mr. Irvin C. Mohler of the A.I.B.S. who spoke briefly about this organization.

Secretary's Report

Miss Waters reported that our total membership as of August 30, is 1,050 as compared with 1,033 last year at this same time. New members for the year totaled 137. Last year there were 142 new members. There have been 134 members dropped, 103 of these being delinquents for the current year. In 1954, 182 members were dropped and 245 in 1953.

Contributing membership has been very encouraging—with 183 members contributing $902.50. Our figure last year was $604.50, 136 members contributing.

In speaking of contributions, the Secretary was pleased to announce that the Chicago Chapter contributed money for a typewriter for the new Secretary's Office, the New York Chapter painted the office, and the Rochester Chapter contributed money for a desk.

Our Sustaining Membership contributions have increased from $380.00 last year to $545.00.

It has been a busy year in the Secretary's Office. A total of 1,726 letters were written and approximately 3,073 pieces of mail have gone out.

Treasurer's Report

Mr. Al Levin reported as follows:

Receipts:		
Bank balance, August 12, 1954		$13,584.69
Membership dues	$6,980.07	
Journal	2,096.15	
Atlantic City meeting	1,081.50	
Miscellaneous	12.83	[illegible]
		[illegible]
Disbursements:		
Association expenses	4,042.07	
Journal	6,992.49	
Atlantic City Meeting	787.71	
Milwaukee Meeting	367.75	12,190.06
Bank balance, August 1, 19[illegible]		$11,569.72
Disbursements	$12,190.06	
Receipts	10,175.09	
Loss	$ 2,014.97	

Constitution and By-Laws

The President advised the membership of the following corrections that should be made in the Constitution and By-Laws, which represent editorial or typographical errors

Page 11, line 1

change: "... Board of Governors of the Executive Committee. – "

to read: *Board of Governors or the Executive Committee*

Page 12 lines 16 and 17

change: "... in accordance with ARTICLE I. SECTION A: ARTICLE I SECTION E: and ARTICLE I. SECTION H PARAGRAPH 1, of these By-Laws - "

to read: *in accordance with ARTICLE I. SECTION A ARTICLE I. SECTION B: ARTICLE I, SECTION E and ARTICLE II. SECTION C. of these By-Laws*

Page 14, lines 18 –

delete: [illegible]

Page 4, line 6 -

delete: *the Annual Business Meeting at which*

Page 15, line 3

change: "... the provisions of SECTION VIII of the "

to read: the provisions of *ARTICLE VIII of the*

A motion was made by Pierre LeDoux that the Constitution and By-Laws be adopted with the above corrections. Passed by membership.

Increase in Dues

The Budget Committee, stated Mr. Sturgis, had been asked to prepare a survey of the financial conditions of the Association and report to the Board. This report pointed out that for some years we had been operating in the black but the Association had not been earned by its members. Due to high cost of the publication of the Journal, we had been losing money on individual members. However, contributions and money realized on Annual Meetings had helped to keep us in the black.

This committee submitted a further report to the Board, in April, 1955, which emphasized that we should be on a self-sustaining basis, with each member paying for the services he receives. We do not know how much longer we will have sustaining funds to carry on. Two or three plans were presented by the committee but the one accepted by the Board contemplated a yearly increase in the amount of $12,000. To meet this figure, taking into consideration the increase in cost and expenses, requires some rather far-reaching changes in our financial structure. The Board voted at the April 16, 1955 meeting to ask the membership to increase the dues to $8.50 and the Journal subscription to $9.00. This was not a hasty action, designed to make B.P.A. rich.

Dues have not been raised for many, many years. All costs, especially printing costs have gone up. As we have grown and expanded, our operations have become more complicated. It would simply be impossible to return to the horse-and-buggy days without paid office help and someone to organize the B.P.A. job. We are becoming more and more well known, one way of which has been through our exhibits. However, all of this requires more mailings of various sorts to our membership. Questionnaires of various committees have been sent out. We are about to launch a publicity campaign which will be expensive. We have already in the last 10 and even 15 years, raised the standards of biological photography and the status of the individual photographer. All of the foregoing boils down to the basic fact that we are trying to give service to our members. We are open for suggestions, and the Board members have received a number already.

We realize the importance of this step that we are about to take with the approval of the membership to increase our dues in order to keep us solvent and in the forefront.

Mr. Charles Lindsay made a motion that the dues be raised to $8.50 and subscription to $9.00. This motion was seconded by Pierre LeDoux and passed by the membership.

1956 Annual Meeting in Rochester, N.Y.

Mr. Beiter stated that the dates for the 1956 meeting are August 28-31 at the Powers Hotel. The rates are a flat $5.50 for single and $8.50 for double. It is the committee's hope to publish a "Meeting Encyclopedia" listing the scientific program, commercial exhibitors and other pertinent data. This "encyclopedia" would be sent to all commercial exhibitors.

Nominations for 1956 Officers and Directors

The following slate of nominees was read by the Secretary. The tellers appointed by the President were: Louis Paul Flory, Chairman, Alex Hamerich and Henry Paplanus.

President:	H. Lou Gibson
Vice President:	John J. Bogan Lardner A. Coffey Leo C. Massopust, Sr.
Secretary:	Jane H. Waters
Treasurer:	Albert Levin
Directors:	William H. Campbell Lt. Stephen P. Dittmann Jack Fason Robert A. Kolvoord Charles Lindsay S. N. Stein, M.D. John E. Withee

Invitation for 1957 Annual Meeting

An invitation by Mr. C. Graham Eddy was extended to the membership to meet in Washington, D.C. in 1957. A motion was made, seconded and passed that this invitation be accepted.

SECOND BUSINESS MEETING SEPTEMBER 2

1957 Invitation by Upper Midwest Chapter

A tentative invitation to the Association to meet in Minnesota in 1957 was extended by the Upper Midwest Chapter. It had been decided since the First Business Meeting to postpone meeting in Washington, D.C. until 1958 due to the fact that the International Exposition of Photography was being held in March of 1957. It was the Board's feeling that our prospective exhibitors might hesitate exhibiting twice during one year in the same city. The membership will be informed either by mail or through the Journal, as soon as a decision is made concerning this tentative invitation.

Auditing Committee

The Auditing Committee, consisting of Paul Jorgensen and Jerry Weinstein, reported that they had found the Treasurer's books all in order.

Election of 1956 Officers and Directors

Mr. Sturgis advised the membership that the following officers and directors had been elected:

President	H. Lou Gibson
Vice President	Leo Massopust, Sr.
Secretary	Jane H. Waters
Treasurer	Albert Levin
Directors	Lt. Stephen Dittmann Robert A. Kolvoord S. N. Stein, M.D.

Best Paper Presented During Milwaukee Meeting

The committee that had been appointed (Messrs. Robert Wolf, Frank Shook and John Withee) advised that they had voted as the best paper presented during the Milwaukee Annual Meeting, "Reptiles" by Sam Dunton and Henry Lester, and felt that a special merit award should be given to those who took part in the Motion Picture Symposium.

BIOGRAPHICAL NOTES ON NEW OFFICERS AND DIRECTORS

Leo C. Massopust, Sr., Director of Department of Art and Photography, Marquette University School of Medicine, Milwaukee, Wis. Associated with Marquette University 38 years; specialized in infrared photography. Has published 31 scientific papers, presented 96 papers before different groups. Has planned and set up 16 exhibits. Member of B.P.A. since 1933. Editor, B.P.A. Journal from 1940 to 1949. Received B.P.A. Annual Award (now Louis Schmidt Award) 1948.

Stephen P. Dittmann, 1st Lt., Medical Service Corps, U.S. Army, Chief, Medical Audio-Visual Dept., and Television Producer, Army Medical Service School Graduate, Washington, D.C. Army assignments have included: Instructor, Signal Corps Photographic Center; Chief, Medical Cinematography Section, Armed Forces Institute of Pathology; Instructor, Tulane University; Chief, Medical Photo Team, Korea. Has written, instructed, and lectured extensively on production and use of medical audio-visual media. Member of B.P.A. since 1945, and of other motion picture and educational television organizations. Army Commendation Ribbon for outstanding contributions in medical photography.

Robert A. Kolvoord, Camera Club and School Service, Eastman Kodak Company, Rochester, N.Y. Professional training at American Academy of Art, Pratt Institute, Clarence H. White School of Photography and Midwestern University. Formerly worked for Daniel-

son Studio, New York City, and North American Aviation, Dallas. Was Director of School of Photography, Hardin College, and Chief of Department of Audio-Visual Services, M.D. Anderson Hospital as well as Professor of Audio-Visual Education, University of Texas Postgraduate School of Medicine, Houston, Texas. Military service in the U.S. Air Force, and as a War Correspondent S. N. Stern, M.D., Head, Physiology Division, Naval Medical Research Institute, Bethesda, Md. Formerly with Paramount Pictures Corp., and Universal Pictures Corp. As Associate Professor in Neurophysiology, University of Illinois College of Medicine, directed and photographed laboratory activities, and developed techniques for cinefluorography and speedlight photomicrography. Present position 4 years. In addition is consultant on audio-visual techniques and photography to the National Institutes of Health, and Technical Advisor in the audio-visual Section of the Bureau of Medicine and Surgery, U.S.N. Several presentations at B.P.A. Annual Meetings.

PHILADELPHIA CHAPTER ARRANGES EXHIBIT

From April 14th through May 11th the Free Library of Philadelphia held a comprehensive exhibition of photography in the display cases in its main entrance hall. This was synchronized with the International Print Exhibition of the Miniature Camera Club of Philadelphia which was held in the special exhibits corridor of the library.

The general preparation and layout of the exhibition was made by Dr. Louis Walton Sipley, director of the American Museum of Photography and the detailed design and installation made by Mr. William Parr and his staff of the Exhibits Department of the Library. The complete show consisted of twelve large vertical display cases and four smaller table type cases. Six of the large cases along the east wall of the hall were filled with apparatus, photographic specimens, and various documentary material related to the various phases through which photography has passed since the days of the daguerreotype down to the modern photographic film.

Each of the large cases (six) along the west wall was given over to some one major field of modern photography. Included were aerial, stereoscopic, motion film, color, photomechanical, and medical photography. The last mentioned case was prepared, at the invitation of Dr. Sipley, by the Philadelphia Chapter of the Biological Photographic Association. The case as it appeared throughout the exhibition is shown in the above photograph. The large prints were mounted on a

black suede paper background with gold cut-out letters. Corrugated gold paper was used for the main background. Inside height of the case was four and one-half feet and length was a bit over six feet.

GROUP INSURANCE PROGRAM EXPLAINED AT BPA CONVENTION

Complete first-hand information on the extensive coverage provided by the BPA Group Insurance Program was available at the Headquarters Booth at the BPA Annual Meeting in Milwaukee. A representative of the Joseph K. Dennis Company, Inc., administrators of the BPA Program was in attendance during the entire meeting to describe the low-cost plans designed for BPA members and their dependents.

Coverages which the BPA Program provides are Comprehensive Loss of Income Protection: benefits for accidental death, benefits for accidental dismemberment, special benefits while you are in the hospital, and polio and dread disease expense benefits.

Four Accident and Sickness Disability Plans are offered with monthly indemnity benefits ranging from $100 to $400 plus accidental death and dismemberment benefits up to $5,000.00.

As a member of BPA you are entitled to the privilege of applying for this exceptional coverage. Any information you desire regarding the coverages and benefits provided by the BPA Group Program can be obtained by writing the Group Insurance Administrators, Joseph K. Dennis Company, Inc., Suite 1027, 175 West Jackson Boulevard, Chicago 4, Illinois.

FRANK CRANDELL AWARDED AN OSCAR

Although a bit late, we want to record that B.P.A. member, Mr. Frank Crandell [illegible] was awarded a technical award last April during the Academy Awards ceremonies. The award was given to Mr. Crandell and Mr. Karl Freund jointly for the development of a direct read-[illegible]

RALPH CREER DISCUSSES MEDICAL FILMS IN EUROPE

Ralph Creer, well known B.P.A. member and Director of Motion Pictures and Medical Television of the A.M.A., gave an illustrated lecture on "The Value of Motion Pictures in Surgical Training" during the 20th Congress of the International College of Surgeons in Geneva, Switzerland. Two years ago Mr. Creer spoke at the First World Conference on Medical Education in London and the International Film Festival in Edinburgh.

MISCELLANEOUS NOTES

JBPA Represented in First Annual Edition of Labstracts.

The editors of Lab World magazine recently compiled an annual called Labstracts containing over 1000 references to current laboratory techniques and methodology. Abstracts of JBPA papers are included. Price is $3.00 from Lab World magazine, 1919 Wilshire Blvd., Los Angeles 57, California.

Fourth Edition of Professional Films Now in Preparation.

Mr. Nathan S. Davis, Secretary, Academy-International of Medicine, 601 Louisiana Street, Lawrence, Kansas has advised that the fourth edition of Professional Films is now in preparation. Film authors who wish to be included should write promptly for questionnaire.

Third International Congress on High-Speed Photography.

The Third International Congress on High-Speed Photography was held in London, England, from the 10th to 15th of September, 1955. It was sponsored by the Department of Scientific and Industrial Research. Congress papers embraced the following main topics:

High sources for high-speed photography and high-speed cinematography.

Mechanical-optical cameras, drum cameras.

High-speed shutters, scanning and image dissection methods.

Recent applications of all these techniques in research, and particularly in the fields of (a) Industrial Machine Analysis, (b) Explosive Studies including Atomic Research, (c) Hydrodynamic and Aerodynamic Research, (d) Medical and Biological Research.

Those wishing information about the proceedings should contact: The Congress Secretariat, Department of Scientific Industrial Research, Charles House, 5-11 Regent Street, London, S.W.1.

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Members may propose for Fellowship in the BPA other members whom they consider worthy of recognition. To be eligible for Fellowship a candidate must have been a member of the Association for five consecutive years and must possess one or more of the following qualifications:

Superior craftsmanship in still or motion picture photography of biological subjects.

Ability in photographic research in new methods or materials.

(These require submission of evidence.)

Meritorious contributions to biological photography overall through sustained organizational work.

Two sponsors are required. The sponsors should be well acquainted with the candidate's work and ready to furnish the Board with details of his experience and achievements. Those who wish to sponsor a member whom they believe to be eligible should request a Fellowship Application form from the Secretary of the Fellowship Committee: Mrs. Maria Ikenberg, University of Illinois, 904 W. Adams Street, Chicago 7, Illinois.

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